

# An In-Vitro Evaluation and Comparison of Apical Sealing Ability of Three Different Obturation Technique - Lateral Condensation, Obtura II, and Thermafil

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## ABSTRACT

**Introduction:** Success of non-surgical root canal treatment is predicted by meticulous cleaning and shaping of the root canal system, three-dimensional obturation and a well-fitting "leakage-free" coronal restoration. The techniques of obturation that are available have their own relative position in the historical development of filling techniques. Over the years, pitfalls with one technique have often led to the development of newer methods of obturation, along with the recognition that no one method of obturation may satisfy all clinical cases.

**Materials and Methods:** A total of 120 extracted human permanent anterior maxillary and mandibular single rooted teeth were selected for the present study and divided into 3 groups based on the method of obturation technique. Following the preparation the patency at the apical foramen was confirmed by passing a file #15. After obturation of all three groups, teeth were immersed in 1% of aqueous methylene blue dye for a period of two weeks and then samples were subjected to spectrophotometric analysis.

**Results:** The present study was conducted to evaluate in vitro the spectrophotometric analysis to quantitatively analyze relative amount of dye penetration using lateral condensation (Group I), Obtura II (Group II), Thermafil obturating technique (Group III) with ZOE sealer used in all groups.

Teeth obturated with lateral condensation (Group I) shows mean value of 0.0243 and standard deviation of 0.0056. The Group II thermoplasticized injectable moulded Guttapercha (Obtura II) showed 0.0239 mean and standard deviation value of 0.0045 and Group III Thermafil obturation technique shows 0.0189 as mean value and 0.0035 standard deviation values.

**Conclusion:** Following conclusion was drawn from the present study.

1. Group III i.e., Thermafil obturating technique shows minimum mean apical dye penetration compared to Group II (ObturaII) and Group I (lateral condensation).
2. Lateral condensation shows maximum mean apical dye penetration in all three groups.
3. There is no significant difference between the apical dye penetration of lateral condensation and Obtura II.

**Keywords:** Obturation, lateral condensation, Obtura II, Thermafil, Spectrophotometer, dye penetration.

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## Introduction

Success of non-surgical root canal treatment is predicted by meticulous cleaning and shaping of the root canal system, three-dimensional obturation, and a well-fitting, "leakage-free" coronal restoration. The techniques of obturation that are available have their own relative position in the historical development of filling techniques. Over the years, pitfalls with one technique have often led to the development of newer methods of obturation, along with the recognition that no one method of obturation may satisfy all clinical cases. It has been well documented over the years since Hess' Classic study in 1925 that the anatomy of root canals is varied and complex.<sup>1</sup> Ingle and Beveridge found 60% of endodontic failure was due to apical leakage. Multiple techniques have been advocated to achieve a perfect seal. Gutta-percha is most frequently used by endodontists because of its inert nature; ability to adapt to the canal walls, low tissue irritation, its permanency (Wein 1996<sup>2</sup>, Grossman 1983<sup>3</sup>) and heated gutta-percha possesses the property of flow. Lateral consideration of gutta-percha has been proven to be a very popular and clinically effective filling technique. However, Schilder reported that final filling by lateral consideration resulted in a non-homogeneous mass of many separate gutta-percha cones pressed together and joined only by friction and the cementing substance<sup>4</sup>. Warm gutta-percha best fulfills the requirements of a root canal filling because homogeneity is provided throughout the entire length of filling. The various thermoplastic techniques Mc Spadden method, ObturaII, Ultrafil, Endotec and Thermafil. In Obtura II, the gutta-percha is heated from temperature range of 160°C to 200°C which is then injected through the needle. In thermafil technique, a metal carrier is used to transport the gutta-percha to working length, then compacted using a single insertion motion.

Sealer is recommended largely for its role as lubricant and to enhance apical seal. The efficacy of a particular obturation technique is based on its ability to provide fluid tight apical seal. The purpose of this study is to evaluate the apical seal invitro by spectrophotometric analysis to quantitatively analyze relative amount of dye penetration using lateral condensation, thermoplasticized injection moulded Guttapercha (Obtura II) and thermafil with ZOE sealer using methylene blue dye penetration study.

## Materials & Methods

A total of 120 extracted human permanent anterior maxillary and mandibular single rooted teeth were selected for the present study, Teeth were inspected for root defects, fractures and matured apex before being selected in the study.

The anatomical crown of each tooth was resected such that all the root length will be standardized to 16mm on a model grinder (Wehmer company). After which the roots were coated with enamel paint, after the second coat of enamel paint gets dried the roots were stored in normal saline.

The working length was determined by placing a k-type file (Mani, Inc) till it was just seen at the apical foramen and then 1mm was subtracted from this length. Standard preparation of the root canals was performed using K-type files to a size # 50 (Mani, Inc). Thus the apical preparation was completed to size fifty and then the canal was flared using a step back technique till size # 70 or by gates glidden. 3% sodium hypochlorite solution (Novo -Dental Products) was used as an irrigant between each instrumentation.

The roots were held in moistened gauze piece to prevent dehydration during instrumentation. Finally, each canal was irrigated copiously with 3% sodium hypochlorite solution using 2ml disposable plastic syringe and needle.

Following the preparation, the patency at the apical foramen was confirmed by passing a file #15 through it (Mani. Inc)

The teeth were stored in normal saline and were classified in to<sup>3</sup> groups of 30 teeth each.

#### **Group -I laterally condensed Guttapercha with sealer (fig 1).**

The teeth were dried with paper point (Diadent). A spreader (Mani. Inc) of the same size as apical instrument size was chosen so that it reaches 1mm short of the apex but did not penetrate through the apical foramen.



**Fig. 1:** X-Ray : Lateral Condensation

A radiograph ensured the fit of the primary point. A zinc oxide eugenol sealer. (Tubliseal – Kerr) was mixed to a creamy consistency as per the manufacturer's instructions. A lentulo- spiral was used for the placement of sealer.

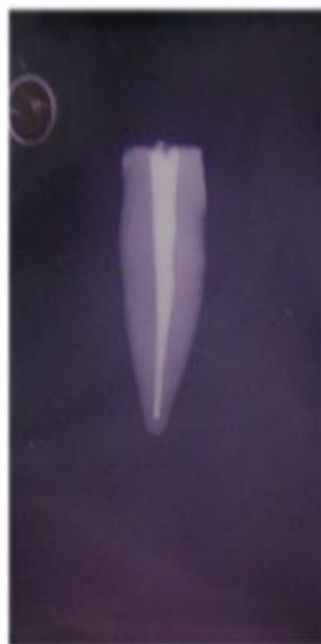
The pre-measured master cone was then coated with the sealer and slowly moved to the full working length.

The spreader was used to laterally condense the accessory gutta-percha cones till a well condensed mass of gutta-percha was obtained. Vertical compaction with a large plugger was then

followed. The excess gutta-percha points which were protruding from the access cavity were resected by a hot spoon excavator. Followed by slight vertical compaction of the material at the access cavity. The access opening was then sealed by Cavit G (ESPE Germany).

#### **Group II – obtura II with sealer (fig 2)**

The Obtura II (Obtura – corp) delivery system was preheated to 16°C. The canals were dried with paper points and then zinc oxide eugenol sealer (Tubliseal Kerr) was mixed to a creamy consistency as per the manufacturer's instruction



**Fig. 2:** X-Ray Obtura II



**Fig. 3:** X-Ray Thermoafil

and was placed by using lentulo spiral.

A 23 gauge applicator tip of the Obtura II system was inserted within 3 to 5mm of working length. The gutta-percha was inserted into the canal by pressing the trigger on the Obtura gun.

The back pressure during the injection process served as a guide for removal of the delivery needle, vertical condensation of gutta-percha mass was done using hand pluggers corresponding to the apical third of the root canals space was accomplished, excess opening was finally sealed with Cavit G.(ESPE Germany).

**Group – III – Thermafil with sealer (fig 3).**

The teeth were dried with paper point (Diadent). Then a verifier (Maillefer – densply) was used to determine the proper size and x-ray was taken to see the fit of the verifier, then a Thermafil obturator was selected according to the size of the Verifier (Size No.50).

By using the calibrations on the carrier, adjustment of the rubber stopper on the obturator was done.

The thermaprep was heated for 15 seconds with obturator. During which the zinc oxide sealer (tubliseal Kerr) was placed by a lentulo spiral and then obturator was inserted to the working distance with firm apical pressure without twisting or rotating, while stabilizing the handle with the index finger, serve the shaft with a round bur with the canal orifice and the access opening was then sealed by Cavit G.

15 teeth in the study were used as a positive control.

In which the teeth were not obturated while 15 remain as a negative control in which the enamel paint was not removed.

After obturation of all three groups, all teeth were immersed in 1% of aqueous methylene blue dye for a period of two weeks.

After 2 weeks, the teeth were recovered from the dye and then the enamel paint was scrapped with a scalpel blade No. 15.

Finally each tooth was dissolved in 50% (10 ml) of nitric acid and the liquid obtained was analyzed under spectrophotometer for the volume of methylene blue present which is directly proportional to the optical density (amount of light absorbed)

**Spectrophotometric Analysis**

This was accomplished using light spectrophotometry. The spectrophotometer CLINICON (Fig4) was used and light transmission was recorded.



**Fig. 4:** Spectrophotometer

All roots were dissolved individually in 10ml of 50% nitric acid.

After which 3ml sample of each solution was placed into a dye recovery spectrophotometer to quantify via light absorption the concentration of dye in each sample which is directly proportional to the Optical density (amount of light absorbed). The higher the spectrophotometric reading the greater was the amount of dye penetration.

**Results**

The present study was conducted to evaluate in vitro the spectrophotometric analysis to quantitatively analyze relative amount of dye penetration using lateral condensation (Group I), Obtura II (Group II), thermafil obturating technique (Group III) with ZOE sealer used in all groups.

The results derived from the present study are as follows:

**Table I-** Illustrate the spectrophotometric values of teeth obturated with lateral condensation (group I), Obtura II (Group II) and Thermafil obturation technique (Group III).

It is observed that group I shows the highest apical dye penetration (0.038) while the Group III showing the lowest (0.013)

**Table II -** In Negative control, no dye penetration was observed (0.00) while in positive control the teeth were not obturated showed maximum dye penetration (1.461).

**Table I: Spectrophotometric Results of Teeth Obturated with Lateral Condensation, Obtura II & Thermafil**

Sl. No.	Lateral Condensation	Obtura II	Thermafil
1.	0.022	0.028	0.020
2.	0.038	0.026	0.013
3.	0.020	0.033	0.017
4.	0.024	0.021	0.021
5.	0.021	0.023	0.014
6.	0.023	0.036	0.021
7.	0.022	0.021	0.018
8.	0.020	0.029	0.019
9.	0.038	0.019	0.023
10.	0.019	0.020	0.017
11.	0.024	0.023	0.022
12.	0.020	0.021	0.016
13.	0.024	0.022	0.014
14.	0.028	0.019	0.021
15.	0.024	0.020	0.019
16.	0.021	0.019	0.017
17.	0.019	0.022	0.019
18.	0.023	0.023	0.021
19.	0.026	0.031	0.026
20.	0.031	0.024	0.018
21.	0.018	0.019	0.014
22.	0.023	0.020	0.017
23.	0.032	0.022	0.021
24.	0.022	0.031	0.020
25.	0.023	0.026	0.022
26.	0.020	0.021	0.019
27.	0.019	0.023	0.021
28.	0.037	0.021	0.028
29.	0.026	0.027	0.016
30.	0.022	0.026	0.014
Min	0.018	0.019	0.013
Max	0.038	0.036	0.028
Mean	0.0243	0.0239	0.018

**Table III** - Teeth obturated with lateral condensation (Group I) shows mean value of 0.0243 and standard deviation of 0.0056. The Group II thermoplasticized injectable moulded Guttapercha (Obtura II ) showed 0.0239 mean and standard deviation value of 0.0045 and group III

Thermafil obturation technique shows 0.0189 as mean value and 0.0035 standard deviation values. The table also illustrates the minimum and maximum amount of dye penetration of three groups.

Table II: Comparison of dye penetration

Sl. No.	Negative Control	Positive Control
1.	0.000	1.328
2.	0.000	1.461
3.	0.000	1.211
4.	0.000	1.321
5.	0.000	1.331
6.	0.000	1.317
7.	0.000	1.297
8.	0.000	1.264
9.	0.000	1.326
10.	0.000	1.324
11.	0.000	1.269
12.	0.000	1.341
13.	0.000	1.319
14.	0.000	1.294
15.	0.000	1.314
Negative Control	0.000	
Positive Control	1.461	

Table III: Mean Spectrophotometric Values and Standard Deviation Values of Different Experimental Groups

Material	No. of Teeth	Range of Leakage		Mean	Standard Deviation
		Min	Max		
Group I Lateral Condensation	30	0.018	0.038	0.0243	0.0056
Group II Obtura II	30	0.019	0.036	0.0239	0.0045
Group III Thermafil	30	0.013	0.028	0.0189	0.0035

**Table IV** denotes a comparison of mean spectrophotometric values between the three groups, comparison in Group I and II.

#### Comparison in Group I and Group II

The 't' value for group I and II is 0.304. The group II shows mean micro leakage less than Group I. The difference is not significant ( $0.7 < p < 0.8$ ).

#### Comparison in Group I and Group III

The 't' value of group I and group III is 4.469. Group III shows less mean leakage value than group I. The difference is highly significant in comparison between group I & III. ( $p < 0.001$ ).

#### Comparison in Group II and Group III

The 't' value for Group II and III is 4.771. The Group III shows mean leakage value less than

Table IV: Comparison of Mean Microleakage Values between the Three Groups

Comparison between Groups	No. of Samples	Range		Mean	SD	't' Values	'p' Values
		Min	Max				
Group I Lateral Condensation & Group II Obtura II	30	18	38	0.0243	0.0056	0.304	0.7<p<0.8 NS
	30	19	36	0.0239	0.0045		
Group I Lateral Condensation & Group III Thermafil	30	18	38	0.0243	0.06656	4.469	P<0.001
	30	13	28	0.0189	0.0035		
Group II Obtura II and Group III Thermafil	30	19	36	0.0239	0.0045	4.771	P<0.001
	30	13	28	0.00189	0.0035		

group II. The difference is highly significant ( $p<0.001$ ).

### Discussion

A major objective of endodontic obturation is to completely obliterate and seal the root canal system while maintaining accurate apical control of the filling material (Scott clerk, 1993)<sup>5</sup>

The Washington study of endodontic success and failure suggests apical percolation of periradicular exudates into the incompletely filled canals as the greatest cause of endodontic failures, (Ingle 1994)<sup>6</sup>

Although apical percolation may be considered as a logical hypothesis. However, the role of the end products of microleakage in the production of periradicular inflammation is open to speculation<sup>13</sup>. It would seem safe to assume that noxious products leaking from the apical foramen acts as an inflammatory irritants<sup>7</sup>.

Thus unless the canal lumen is sealed by obturation, the irritants, metabolites and microorganism that may cause periapical

breakdown have the opportunity to return, which may lead to recurrence or flare up of the pre-existing lesion.

Kavitha Anantula and Anil Kumar Ganta compared sealing ability of three different obturation techniques — Lateral condensation, Obtura II, and GuttaFlow and concluded that Obtura II group exhibited a homogenous obturation followed by lateral condensation and GuttaFlow and Obtura II exhibited good adaptation followed by GuttaFlow and lateral condensation<sup>8</sup>

Guttapercha is by far the most universally used solid core root canal filing material since its introduction by Bowman in 1867. Well obturated root canals utilizing the lateral condensation technique have been shown to lack accurate replication of the intricacies of the root canal system and homogeneity (Clerk Scott, 1993)<sup>4</sup>.

The study evaluated the apical seal produced by lateral condensation technique, injectable

thermoplasticized Gutta percha (obtura II) and the Thermafil obturating technique.

Matloff et al (James Haddix, 1991)<sup>9</sup>, showed that methylene blue dye penetrates further than radioisotopes, thereby giving a more accurate assessment of marginal leakage.

Dental application for dye recovery method (spectrophotometry) was first described by Douglas and Zakariasen. This method minimizes human measurement error and provides determinations of volume leakage rather than liner measurement.

A total of 120 single rooted maxillary anterior teeth were biomechanical prepared using a step back technique. The teeth were classified in 3 groups. Group I was obturated using lateral condensation Group II was obturated using thermoplasticized injectable moulded Guttapercha (Obtura II) technique, while Group III was obturated using Thermafil obturating technique (Table No. I)

In all groups ,ZOE Sealer was used,15 teeth not obturated acted as a positive control showing maximum dye penetration while 15 teeth remained as negative control in which the enamel paint was not scraped showing no (0.00)dye penetration (Table No.II).

The mean apical dye penetration in lateral condensation group was 0.0243 and that seen in Obtura II was 0.0239 while the Thermafil obturating technique showed minimum mean dye penetration 0.0189 (Table No. III)

Statistically no significant difference was found in teeth obturated with lateral condensation and Obtura II ( $0.7 < p < 0.8$ ). However statistically significant difference was found between the teeth obturated with lateral condensation and Thermafil obturating technique ( $p < 0.001$ ), also statistically significant difference was found between Obtura II and Thermafil ( $P < 0.001$ ) (Table No.IV). While Thermafil obturating technique showed minimum apical dye penetration (0.013) (Table No. III).

In case of Thermafil obturating technique during the study as well as radiographically maximum specimen showed extrusion of the sealer. (D. Scott Clark 1993<sup>5</sup>, Mahmoud E.Eldeeb, 1993<sup>10</sup>, Kenan Clinton2001<sup>11</sup>).

The present study has shown that Thermafil obturating technique produces superior apical seal compared to lateral condensation and Obtura II. The results of this study can be correlated with the previous studies by Beatty 1989<sup>4</sup>, Kenan Clinton 2001<sup>11</sup>.

Lumnije K, Weiglein A, Städtler P radiographically assessed five obturation techniques and concluded that All thermoplastic obturation techniques demonstrated acceptable root canal filling and sealed well with no statistically significant difference between them and in comparison to lateral condensation<sup>12</sup>.

## Conclusion

Following conclusion was drawn from the present study.

1. Group III i.e., Thermafil obturating technique shows minimum mean apical dye penetration compared to Group II (Obtura II) and Group I (lateral condensation).
2. Larteral condensation shows maximum mean apical dye penetration in all three groups.
3. There is no significant difference between the apical dye penetration of lateral condensation and Obtura II technique.
4. Extrusion of sealer in maximum specimens were seen for Thermafil obturating technique.

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