



# The Comparison of Apical Leakage between Two Obturation Techniques (Cold Lateral Condensation and Obtura II) by Using Fluid Filtration Method

Maryam Bidar,<sup>1</sup> Shima Nabavi,<sup>2</sup> Mohammadtaghi Shakeri,<sup>3</sup> Mona Zamanpour,<sup>4</sup> and Hamid Jafarzadeh<sup>5,\*</sup>

<sup>1</sup>Dental Research Center, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>2</sup>General Dentist, Mashhad, Iran

<sup>3</sup>Social Determinants of Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>4</sup>Department of Restorative Dentistry, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

<sup>5</sup>Department of Endodontics, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

\*Corresponding author: Hamid Jafarzadeh, Faculty of Dentistry and Dental Research Center, Vakilabad Blvd, P.O. Box 91735-984 Mashhad, Iran. Tel: +98-5138829501, Fax: +98-5138829500, E-mail: jafarzadehbh@mums.ac.ir

Received 2017 March 03; Revised 2017 July 08; Accepted 2017 November 13.

## Abstract

**Background:** The aim of this study was to compare the apical sealing ability of cold lateral condensation and Obtura II by using fluid filtration method.

**Methods:** Thirty four single-canal mandibular premolars with mature apices and apical curvature less than 20 degrees were selected. For obtaining complete similarity among samples, all teeth were shortened to 15 mm by cutting the remained crown. For canal preparation, the manual step-back technique by K-files was used. The teeth were divided into two experimental groups (each group included 15 teeth), positive controls (n = 2), and negative controls (n = 2). Teeth in group 1 and 2 were obturated with cold lateral condensation and Obtura II, respectively. To allow the sealer to set, all teeth were stored at 100% humidity and 37°C for the next seven days. For measurement of apical leakage, fluid filtration method was used. The amount of leakage in each canal was recorded as  $\mu\text{L}/\text{min}/\text{cm H}_2\text{O}$ . Independent T-test was used for statistical analysis.

**Results:** Teeth obturated with cold lateral condensation showed significantly more leakage than those obturated with Obtura II (P value = 0.022).

**Conclusions:** Obtura II may obtain better apical seal than cold lateral condensation.

**Keywords:** Endodontics, Leakage, Root Canal Obturation

## 1. Background

Creation of hermetic seal is the main aim of root canal therapy. After completion of the cleaning and shaping of the canal, a perfect obturation can help to prevent the entrance of bacteria and their toxins to the periapical tissues and reach this aim (1).

The most common method for obturating the root canal is considered to be the cold lateral condensation technique using gutta-percha cones and canal sealers; however, it seems that a real homogeneous mass of gutta-percha cannot be obtained by this technique because a great number of gutta-percha points tightly pressed together. It has some advantages such as control of the point placement and simple/rapid to carry out (1-3).

In 1977, Yee et al. (4) developed the first device for obturating the canal using injection-modeled thermoplas-

ticized gutta-percha. However, the first commercial system was Obtura II. The Obtura II is easy to use and is useful for irregular canals. This device can heat gutta-percha up to 200°C which can prepare gutta-percha for being injected into the canal (1). Some advantages have been considered for Obtura II including high adaptation with dentinal walls, short time-consuming, easy application, and decreasing in the possibility of vertical root fracture. Disadvantages of this system are its need to canal enlargement especially in connecting area of apical third and middle third, possibility of damage to the periodontium, possibility of overfilling, and possibility of extrusion of sealers from apical foramen (5). This system probably cannot provide a hermetic seal too (1).

For evaluation of the apical leakage, various methods have been introduced, some of them are no longer recom-

mended such as dye leakage. Some other ways for this purpose is fluid filtration and microbial leakage; both of them have significant value (2, 6). The aim of this study was to compare the sealing ability of cold lateral condensation and Obtura II by using fluid filtration method.

## 2. Methods

For this *in vitro* study which had been approved by research commission of Mashhad University of Medical Sciences (MUMS), thirty four human extracted mandibular premolars were selected. All these teeth had mature apices and apical curvature was less than 20 degrees. For determination of canal curvature, Schneider's method by using radiographs and AutoCad software (Auto Desk Inc., San Raphael, California) was used. All of the selected teeth had single root, single canal, and only one apical foramen evident in radiographs taken in two directions. Teeth with calcification, visible cracks, fractures, or resorption were excluded.

For removal of calculus and soft tissues, mechanical preparation of the root surface was performed by using periodontal scalers (Hu-Friedy, Chicago, USA) followed by placement of teeth in 5.25% sodium hypochlorite for two hours.

For obtaining complete similarity among samples, all selected teeth were shortened to 15 mm by cutting the remained crown with a diamond bur (Dentsply, Tulsa, USA). Determination of working length of each canal was performed using #15 K-file (Maillefer, Dentsply, Germany). For root canal preparation, the manual step-back technique by K-files (Maillefer, Dentsply, Germany) was used and apical preparation was continued up to #30. For coronal preparation, gates-glidden drills (#1 - 3) (Maillefer, Dentsply, Germany) were used. After each instrument, irrigation was performed with 2cc sodium hypochlorite in a passive manner. Canals were finally irrigated with 4cc of normal saline. The canals were carefully dried using paper points (Ariadent Co, Tehran, Iran).

After this stage, the teeth were divided into two experimental groups (each group included 15 teeth), positive controls ( $n = 2$ ), and negative controls ( $n = 2$ ), with random processing using <http://www.randomization.com>. Teeth in group 1 were obturated with cold lateral condensation. The master cone was considered as #30 and the sealer used was AH26 (Dentsply, Konstanz, Germany). Teeth in group 2 obturated with Obtura II. The temperature was set at 170°C. The gauge of needle used was #25 and the sealer used was AH26 (Dentsply, Konstanz, Germany). In both groups, the coronal seal was obtained by Cavit (Premier, PA, USA). To allow the sealer to set, all teeth were stored at 100% humidity and 37°C for the next seven days.

For measurement of apical leakage, fluid filtration method was used. The procedure was based on Moradi et al. study (7). For taking photographs, 30 seconds was considered to attain system balance. Next pictures were taken at 2, 4, 6, and 8 minutes after recording the first picture by a digital camera (Lumix, Panasonic). The distance between the camera and micro-pipette was 32 cm. All 5 photographs of each sample were then transferred to the computer and the bubble movement was measured by using Photoshop 6 software. The amount of leakage in each canal was recorded as  $\mu\text{L}/\text{min}/\text{cm H}_2\text{O}$ . Statistical analysis was performed by using SPSS (version 16; SPSS Inc, Chicago, IL). Findings were analyzed using Independent T-test.

## 3. Results

In this study, 30 teeth were used as the cases, two teeth as positive control and two teeth as negative control. In positive control teeth, after creating enough force through the system, the bubble moved in the micro-pipette which confirmed total leakage in positive controls. In negative controls, during forcing (8 minutes) no movement was observed in the bubble which proved the reliability of the system.

In cases teeth, after evaluation of the leakage by fluid filtration method, the maximum, minimum, and mean of the microleakage were recorded which have been summarized in Table 1.

The T-independent test showed that there is a significant difference between two groups. The mean value of apical leakage in lateral condensation group was significantly more than Obtura II group ( $P$  value = 0.022) which shows that apical seal by Obtura II is significantly better than lateral condensation technique.

## 4. Discussion

Apical leakage is the result of microscopic gaps between filling material and dentinal walls or gaps in the body of the filling material itself. This is considered as the most common way for transmission of bacteria in the canal (8). More than half of the endodontic failures are due to inability in preventing this leakage (1). This study was performed to compare the sealing ability of cold lateral condensation and Obtura II by using fluid filtration method. The results revealed that canals obturated with cold lateral condensation showed significantly more leakage than those obturated with Obtura II.

Different methods have been used for measuring the apical leakage. Some of these methods are dye leakage, bacterial penetration, radioisotopes, light microscopic meth-

**Table 1.** Brief Results of the Fluid Filtration Method

Group	Sample Size	Maximum	Minimum	Mean	Standard Deviation
Lateral condensation	15	9.975	0.001	2.0504	3.2232
Obtura II	15	2.612	0.0004	0.1778	0.6735

ods, and scanning electron microscope. An important disadvantage of these methods is that they prepare qualitative data. This means that they cannot reveal the amount of leakage. For overwhelming this problem, fluid filtration which is a quantitative method has been introduced to increase the reproducibility and reliability (7). Via this method, apical seal is evaluated by movement of air bubble in a micro-pipette resulting from entering fluid into unsealed areas of apical portion (1). Some advantages have been considered for this method including no destruction of the samples (the possibility of re-evaluation), permitting the evaluation over time, and no need to tracer and intricate material. Also, this method avoids any operator bias and even very small volumes can be recorded. However, this method has some disadvantages. For example, the tube diameter has a considerable effect on the results. Also, the increase in pressure would result in more fluid filtration, whereas the increase in time would have the reverse effect on fluid filtration (2, 7).

In the present study, fluid filtration method was used and concluded that teeth obturated with cold lateral condensation showed significantly more leakage than those obturated with Obtura II. However, some studies have used dye penetration method and concluded that there is no significant difference between these two obturation techniques (9-11). By this method of assessment, Al-Dewani et al. (12) showed that Obtura II had better seal ability than lateral condensation. Weller et al. (13) used split-tooth model and showed that Obtura II had better adaptation to the canal comparing with lateral condensation. Another study concluded that Obtura II produced better bacterial seal comparing lateral condensation, using anaerobic bacterial leakage model (14). Hata et al. (15), by measurement of resin penetration, showed no significant difference in apical leakage between these obturation techniques. Some new techniques such as microtomography have been shown to be useful devices for quantitative evaluation of root canal filling too (16). Emmanuel et al. (17) in 2013 using methylen blue dye showed that dye penetration in samples obturated by cold lateral condensation technique is similar to those obturated by Obtura II. Cold lateral condensation technique and Obtura II have also compared in clinical studies. Ansari et al. (18) concluded that there is no significant difference between these two tech-

niques regarding voids and apical termination.

It should be emphasized that some factors may influence the results of studies use fluid filtration method. In fluid filtration system we used, the pressure was set at 0.5 a whereas other researchers have used different pressures. Pommel et al. (19) used 15 cm-H<sub>2</sub>O, Bobotis et al. (20) applied 20 psi pressure, and Wimonchit et al. (21) used 100 mmHg pressure. The difference in the pressure between various studies seems not to be important because the pressure in each study is applied similarly for all cases.

Although Obtura II seems to be a suitable device for root canal obturation, some concerns have been raised regarding damage to the periodontal ligament cells and bone due to the high temperature of Obtura II. However, several studies concluded that the temperature of external surfaces of the root after application of Obtura II is below the critical 10°C (22-25).

Regarding the apical diameter, a recent study showed that a minimum apical preparation of size 30 is needed for obturation with Obtura (26). In another interesting study in 2016, it was shown that Obtura II and cold lateral condensation techniques have similar resistance to bacterial leakage when used to fill apical part (5 mm) of the root canal while leaving the rest of the root canal unfilled (27).

Because of some limitations of this study such as limited sample size, evaluation device, the effect of canal curvature, size of apical preparation, and longer duration on the sealing ability, further studies should be performed.

## Acknowledgments

This article is based on Shima Nabavi's undergraduate thesis (No. 2478). It has been supported in part by dental research center and the vice chancellor for research of Mashhad University of Medical Sciences.

## References

- Cohen S, Hargreaves KM. *Pathways of the Pulp*. 9th ed. Louis: Mosby; 2006.
- Leduc J, Fishelberg G. Endodontic obturation: a review. *Gen Dent*. 2003;**51**(3):232-3. [PubMed: [15055706](#)].
- Zhang W, Suguro H, Kobayashi Y, Tsurumachi T, Ogiso B. Effect of canal taper and plugger size on warm gutta-percha obturation of lateral depressions. *J Oral Sci*. 2011;**53**(2):219-24. doi: [10.2334/josnusd.53.219](#). [PubMed: [21712627](#)].

4. Yee FS, Marlin J, Krakow AA, Gron P. Three-dimensional obturation of the root canal using injection-molded, thermoplasticized dental gutta-percha. *J Endod.* 1977;3(5):168-74. doi: [10.1016/S0099-2399\(77\)80091-5](https://doi.org/10.1016/S0099-2399(77)80091-5). [PubMed: 266025].
5. Anthony J. Gutta percha obturation techniques. *Clin Tech Small Anim Pract.* 2001;16(3):155-8. doi: [10.1053/svms.2001.26461](https://doi.org/10.1053/svms.2001.26461). [PubMed: 11765526].
6. Bidar M, Moradi S, Jafarzadeh H, Bidar S. Comparative SEM study of the marginal adaptation of white and grey MTA and Portland cement. *Aust Endod J.* 2007;33(1):2-6. doi: [10.1111/j.1747-4477.2007.00053.x](https://doi.org/10.1111/j.1747-4477.2007.00053.x). [PubMed: 17461833].
7. Moradi S, Naghavi N, Rohani E, Javidi M. Evaluation of microleakage following application of a dentin bonding agent as root canal sealer in the presence or absence of smear layer. *J Oral Sci.* 2009;51(2):207-13. doi: [10.2334/josnusd.51.207](https://doi.org/10.2334/josnusd.51.207). [PubMed: 19550088].
8. Bidar M, Hooshair S, Naderinasab M, Moazzami M, Orafaee H, Naghavi N, et al. Comparative study of the antimicrobial effect of three irrigant solutions (chlorhexidine, sodium hypochlorite and chlorhexidinated MUMS). *J Contemp Dent Pract.* 2012;13(4):436-9. doi: [10.5005/jp-journals-10024-1164](https://doi.org/10.5005/jp-journals-10024-1164). [PubMed: 23151688].
9. Silva-Herzog D, Jacome Musule JL, Martinez Moreno L, Canas SE. [Making a mernetic root seal]. *Pract Odontol.* 1989;10(5):21-4-30-1. [PubMed: 2638013].
10. Olson AK, Hartwell GR, Weller RN. Evaluation of the controlled placement of injected thermoplasticized gutta-percha. *J Endod.* 1989;15(7):306-9. doi: [10.1016/S0099-2399\(89\)80052-4](https://doi.org/10.1016/S0099-2399(89)80052-4). [PubMed: 2638390].
11. De Nys M, Martens L, De Coster W, Thys M. Evaluation of dowel space preparation on the apical seal using an image processing system. *Int Endod J.* 1989;22(5):240-7. doi: [10.1111/j.1365-2591.1989.tb00517.x](https://doi.org/10.1111/j.1365-2591.1989.tb00517.x). [PubMed: 2700183].
12. Al-Dewani N, Hayes SJ, Dummer PM. Comparison of laterally condensed and low-temperature thermoplasticized gutta-percha root fillings. *J Endod.* 2000;26(12):733-8. doi: [10.1097/00004770-200012000-00018](https://doi.org/10.1097/00004770-200012000-00018). [PubMed: 11471644].
13. Weller RN, Kimbrough WF, Anderson RW. A comparison of thermoplastic obturation techniques: adaptation to the canal walls. *J Endod.* 1997;23(11):703-6. doi: [10.1016/S0099-2399\(97\)80406-2](https://doi.org/10.1016/S0099-2399(97)80406-2). [PubMed: 9587313].
14. Jacobsen EL, BeGole EA. A comparison of four root canal obturation methods employing gutta-percha: a computerized analysis of the internal structure. *Endod Dent Traumatol.* 1992;8(5):206-12. doi: [10.1111/j.1600-9657.1992.tb00244.x](https://doi.org/10.1111/j.1600-9657.1992.tb00244.x). [PubMed: 1302681].
15. Hata G, Kawazoe S, Toda T, Weine FS. Sealing ability of thermoplasticized gutta-percha fill techniques as assessed by a new method of determining apical leakage. *J Endod.* 1995;21(4):167-72. doi: [10.1016/S0099-2399\(06\)80559-5](https://doi.org/10.1016/S0099-2399(06)80559-5). [PubMed: 7673814].
16. Kierklo A, Tabor Z, Petryniak R, Dohnalik M, Jaworska M. Application of microcomputed tomography for quantitative analysis of dental root canal obturations. *Postepy Hig Med Dosw (Online).* 2014;68:310-5. doi: [10.5604/17322693.1095271](https://doi.org/10.5604/17322693.1095271). [PubMed: 24864081].
17. Emmanuel S, Shantaram K, Sushil KC, Manoj L. An In-Vitro Evaluation and Comparison of Apical Sealing Ability of Three Different Obturation Technique - Lateral Condensation, Obtura II, and Thermafil. *J Int Oral Health.* 2013;5(2):35-43. [PubMed: 24155589].
18. Ansari BB, Umer F, Khan FR. A clinical trial of cold lateral compaction with Obtura II technique in root canal obturation. *J Conserv Dent.* 2012;15(2):156-60. doi: [10.4103/0972-0707.94591](https://doi.org/10.4103/0972-0707.94591). [PubMed: 22557815].
19. Pommel L, Jacquot B, Camps J. Lack of correlation among three methods for evaluation of apical leakage. *J Endod.* 2001;27(5):347-50. doi: [10.1097/00004770-200105000-00010](https://doi.org/10.1097/00004770-200105000-00010). [PubMed: 11485254].
20. Bobotis HG, Anderson RW, Pashley DH, Pantera EJ. A microleakage study of temporary restorative materials used in endodontics. *J Endod.* 1989;15(12):569-72. doi: [10.1016/S0099-2399\(89\)80151-7](https://doi.org/10.1016/S0099-2399(89)80151-7). [PubMed: 2639956].
21. Wimonchit S, Timpawat S, Vongsavan N. A comparison of techniques for assessment of coronal dye leakage. *J Endod.* 2002;28(1):1-4. doi: [10.1097/00004770-200201000-00001](https://doi.org/10.1097/00004770-200201000-00001). [PubMed: 11806641].
22. Eriksson AR, Albrektsson T. Temperature threshold levels for heat-induced bone tissue injury: a vital-microscopic study in the rabbit. *J Prosthet Dent.* 1983;50(1):101-7. doi: [10.1016/0022-3913\(83\)90174-9](https://doi.org/10.1016/0022-3913(83)90174-9). [PubMed: 6576145].
23. Weller RN, Koch KA. In vitro radicular temperatures produced by injectable thermoplasticized gutta-percha. *Int Endod J.* 1995;28(2):86-90. doi: [10.1111/j.1365-2591.1995.tb00164.x](https://doi.org/10.1111/j.1365-2591.1995.tb00164.x). [PubMed: 7665206].
24. Gutmann JL, Rakusin H, Powe R, Bowles WH. Evaluation of heat transfer during root canal obturation with thermoplasticized gutta-percha. Part II. In vivo response to heat levels generated. *J Endod.* 1987;13(9):441-8. doi: [10.1016/S0099-2399\(87\)80062-6](https://doi.org/10.1016/S0099-2399(87)80062-6). [PubMed: 3482103].
25. Sweatman TL, Baumgartner JC, Sakaguchi RL. Radicular temperatures associated with thermoplasticized gutta-percha. *J Endod.* 2001;27(8):512-5. doi: [10.1097/00004770-200108000-00004](https://doi.org/10.1097/00004770-200108000-00004). [PubMed: 11501588].
26. Tanikonda R, Nalam PN, Sajjan GS, Lakshmi BH, Varma KM, Satish RK. Evaluation of the Quality of Obturation with Obtura at Different Sizes of Apical Preparation Through Microleakage Testing. *J Clin Diagn Res.* 2016;10(4):ZC35-8. doi: [10.7860/JCDR/2016/15727.7584](https://doi.org/10.7860/JCDR/2016/15727.7584). [PubMed: 27190948].
27. Balto HA. Obturation Techniques Allow Microbial Leakage Unless Protected. *J Prosthodont.* 2016;25(3):224-8. doi: [10.1111/jopr.12300](https://doi.org/10.1111/jopr.12300). [PubMed: 25996203].