ORIGINAL ARTICLE

RADIOGRAPHIC COMPARISON OF OBTURATION PERFORMED BY CONVENTIONAL METHOD AND OBTURA II

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Background: Preventing tooth loss is of utmost importance in maintaining optimal mastication, phonation, and aesthetics. Most commonly, pulpitis occurs as a result of caries, while trauma less frequently causes it. In both cases, it can lead to unbearable pain. To alleviate this pain and preserve the tooth without resorting to extraction, root canal treatment is indicated. To compare the radiographic quality of root canal filling sealing achieved with the Obtura II system and the cold lateral condensation technique. **Methods:** This randomized clinical trial was conducted at the School of Dentistry with a total of 260 participants. The study focused on single-rooted teeth that required endodontic treatment. Group A was assigned the cold lateral condensation, while Group B received obturation using the Obtura II system. A radiographic assessment was performed to evaluate the presence of voids and the extent of extension at the apex in both groups. The chi-square test was utilized to compare the occurrence of voids and the extent of extension between the two groups. **Results:** In the Cold Lateral Compaction cold lateral condensation group, 113 cases (86.92%) achieved optimum extension, while in the Obtura II group, 114 cases (87.69%) achieved the same. A statistically significant difference was observed between the groups in terms of extension (p=0.033). Although the difference in extension quality was not statistically significant, it is worth noting that the Obtura II group had a higher incidence of overextension. The cold lateral condensation group had 104 cases (80.00%) with no voids, whereas the Obtura II group had 121 cases (93.08%) without voids. A statistically significant difference was observed between the groups regarding the presence of voids (p=0.004). **Conclusion:** Obtura II exhibits a denser sealing and fewer voids compared to the cold lateral condensation technique. However, Obtura II showed a slightly higher tendency to extend beyond the apex compared to the CLC technique.

Keywords: Endodontic treatment; Cold lateral condensation; Obtura II; Obturation; Radiographic assessment

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INTRODUCTION

Preventing tooth loss is of utmost importance in maintaining optimal mastication, phonation, and aesthetics.[1] Most commonly, pulpitis occurs as a result of caries, while trauma less frequently causes it. In both cases, it can lead to unbearable pain.[2] To alleviate this pain and preserve the tooth without resorting to extraction, root canal treatment is indicated.[3]

Root canal therapy is a significant component of dental healthcare, emphasizing the importance of achieving a successful endodontic treatment.[4] One crucial factor that determines the effectiveness of such treatment is the quality of the root canal filling. The primary objective of a root canal filling is to completely seal and obliterate the root canal system using a stable and biocompatible material. By doing so, it prevents the infiltration of microorganisms and tissue fluids into the root canal system, ensuring its long-term health and integrity.[5] The ability of an obturation technique to form a seal at the apex, preventing the passage of fluids, determines its effectiveness. Root canal treatments (RCTs) have a success rate exceeding 90%.[6] The attainment of successful endodontic therapy hinges upon three essential factors: precise diagnosis, thorough biomechanical preparation, and the three-dimensional obturation of the root canal system.[7]

Cold lateral compaction, considered the standard for obturation techniques worldwide, is widely taught and practised. It serves as the reference point for evaluating other filling methods. This technique offers several benefits, such as cost-effectiveness and the ability to precisely control the filling length.[8] However, its ability to conform to the internal surfaces of the root canal has been questioned due to voids, spreader tracts, incomplete fusion of gutta-percha cones, and lack of surface adaptation.[9]

Extensive research has shown that the Obtura II system surpasses lateral-condensation methods by a significant margin and exhibits the highest level of adaptation to the three-dimensional root canal system.[10] The utilization of thermoplasticized gutta-percha with the Obtura II system enables its application in challenging scenarios like internal resorptions, curved canals, open apex (blunderbuss), perforations, and canal calcifications. However, it should be noted that length control poses a disadvantage, as there is a higher risk of both under- and over-extended obturations.[11] Despite the extensive number of in vitro studies that have compared the outcomes of root canal obturation using warm Gutta-percha and Cold lateral condensation, the conclusions derived from these studies have shown inconsistency or contradiction.[12, 13] The present study, designed as an in vivo investigation with a large sample size and well-controlled design, will effectively address the research question.

The null hypothesis for this study posits that there is no significant difference in the quality of obturation achieved between the conventional method and Obtura II when evaluated through radiographic comparison. The potential benefits of this research extend to various stakeholders within the dental field. Patients may experience improved treatment outcomes, ensuring their oral health and well-being. Dentists can make more informed decisions about obturation techniques, leading to enhanced precision and efficiency in their practice. Furthermore, the broader community may benefit from reduced healthcare costs and optimized resource allocation as a result of this study's findings.

The objective of this study was to compare the radiographic quality of root canal filling sealing achieved with the Obtura II system and the cold lateral condensation technique.

MATERIAL AND METHODS

This randomized clinical trial of parallel design was carried out at the School of Dentistry (PIMS, FMTI from October 1st, 2021, to April 30th, 2022 on 260 participants after ethical board approval (SOD/ERB/2022/15). The trial is registered on Clinicaltrials.gov under the number (NCT05711511). The sample size was determined using the WHO calculator, resulting in a total of 260 participants, with 130individuals assigned to each group. The level of significance was set at 5%, and the power of the test was set at 80%. Anticipated proportions were 16.67% for Group 1 (cold lateral) and 6.67% for Group 2 (Obtura II).[10]

A non-probability sampling technique was employed for sample selection. Inclusion criteria for the study were as follows: single-rooted teeth in which endodontic treatment was clinically indicated, and single-rooted teeth in which root canal treatment was recommended for elective reasons. Exclusion criteria included teeth with severely curved roots, sclerosed canals observed on periapical radiographs, periodontally compromised teeth, cases requiring endodontic retreatment, teeth with apical resorption, teeth that were not salvageable by conventional root canal treatment, and third molars.

A written informed consent was obtained from all participants. Patients who had undergone preparation and pulpectomy and registered in department of operative dentistry were randomized using block randomization technique with each block size of 20 participants. Each block was further randomized into two interventions (group I: cold lateral condensation and group II: Obtura II) using simple randomization using computer generated number Microsoft excel 2016 sheet.

Local anesthesia was administered using 2% lidocaine with epinephrine 1:80,000 through infiltration in the upper arch and an inferior alveolar nerve block in the lower arch. Temporary restorations were removed, providing access to the cavity, and the root canal was meticulously irrigated with saline and 5.25% sodium hypochlorite. The working length was verified using an apex locator, referring to the master apical file indicated in the patient's records. Reshaping of the canal was performed using the designated master apical file. using proceeding to obturation each canal was dried using absorbent paper.

For group A, the cold Lateral compaction technique was applied, a hand spreader was carefully selected, followed by the liberal application of a calcium hydroxide-based sealer (SealApex) using a paper point to coat the canal walls. A standardized gutta-percha cone, corresponding to the master apical file, was placed at the working length, and a measured No. 25 spreader was vertically loaded for 10–60 seconds. This action allowed for the deformation of the material both apically and laterally. The spreader was then withdrawn in a watch-winding motion to ensure that the master cone remained in place, and the first accessory cone was promptly inserted with a light coating of sealer, ensuring the proper length. The compaction and insertion of accessory cones continued, with each subsequent spreader insertion slightly less deep than the previous one, resulting in shorter accessory cone insertions. This process was repeated until the spreader reached a maximum depth of 2–3 mm into the canal. Heat was applied using a Touch' N Heat device (Sybron Endo) to the root filling, specifically at or below the level of the canal orifice, followed by apical compaction using a cold plugger. To provide a coronal seal, glass ionomer

cement was used as a lining, and the appropriate restoration was then placed.

The instructions provided by the manufacturer were diligently followed for the Obtura II system. Paper points were utilized to apply a thin layer of Calcium hydroxide sealer (SealApex) to the canal wall. A 23-gauge needle was carefully selected, and a rubber stopper was inserted to indicate a depth of 4–6 mm from the working length. After turning on the control unit of the Obtura II, the display indicated that the required temperature of 185 °C was reached within a few minutes, adhering to the instructions provided in the manual. A fresh pellet of gutta-percha was loaded into the gun, and the plunger was pushed forward. Prior to usage, a small amount of gutta-percha was expressed to preheat the needle. The needle was then positioned within the canal, ensuring it reached a distance of 3–5 mm from the apical preparation. Approximately 3–4 mm of gutta-percha was passively injected without applying apical pressure, followed by gentle compaction using a #11 endodontic plugger previously marked with a rubber stopper to guarantee it fell short of the working length by at least 3 mm. To prevent adhesion with the molten gutta-percha, the plugger was dipped in alcohol, effectively creating the apical plug. A segmental technique was employed, injecting and compacting gutta-percha in sequential increments of 3–4 mm. This process was repeated until the gutta-percha reached the level of the top orifice, after which compaction was performed using a cold plugger. Any excess gutta-percha located at or below the orifice level was carefully removed using a Touch' N Heat device. To ensure a coronal seal, glass ionomer cement was used as a lining, followed by the placement of the appropriate restoration. Subsequently, a radiographic assessment of the obturation was conducted.

The quality of obturation in both groups was evaluated through the use of postoperative periapical radiographs, employing the parallax technique. The radiographs were examined using a ×2 magnification loupe under proper illumination in a darkened room. This meticulous examination aimed to identify any voids and ensure the adequacy of radiographic length. Given the clinical setting, our study focused on the radiographic assessment of the bucco-lingual view of the canals, as it provided the only feasible perspective for visualizing the endodontic treatment's quality on the radiograph. This approach was chosen to minimize the number of radiographs necessary to accomplish the study objectives.

The root canal fillings were categorized based on several criteria. Firstly, they were assessed for the presence or absence of voids. Additionally, the position of the filling within the root canal system and its proximity to the radiographic apex were evaluated. A filling that was deemed acceptable or flush indicated that it resided within the root canal system and was located within 2 mm of the radiographic apex. On the other hand, an under-filled filling indicated that it fell short of the radiographic apex by more than 2 mm. Conversely, an over-filled filling referred to a situation where the root canal filling extended beyond the radiographic apex.

The data collected was entered into Microsoft Excel 2016 and subsequently imported into R programming version 4.1.2 for further analysis. Descriptive statistics were performed to provide an overview of the data, including frequencies with percentages for qualitative variables such as gender and the quality of obturation in both groups. For continuous data like age, the mean and standard deviation were calculated. To compare the quality of obturation between the lateral condensation and Obtura II system, a chi-square test was employed. The significance level was set at $p<0.05$, indicating statistical significance.

RESULTS

Table-1 presents the characteristics of the study participants in terms of age, gender, and age group. The mean age was 34.58±10.86 years. In terms of gender distribution, 124 participants (47.69%) were female, while 136 participants (52.31%) were male. The participants were further categorized into different age groups. Among them, 119 individuals (45.77%) fell into the age group of 18–30, 95 individuals (36.54%) belonged to the age group of 31–45, and 46 individuals (17.69%) were in the age group of 46–60.

Table-2 presents the characteristics of the study participants according to the obturation technique used, namely Cold Lateral Condensation and Obura II. The sample size for each technique was 130. In terms of age, the participants who received Cold Lateral Condensation had a mean age of 33.79 years with a standard deviation (SD) of 11.25 years, while those who received Obura II had a mean age of 35.38 years with an SD of 10.43 years. The difference in mean ages between the two groups was not statistically significant ($p=0.24$), as determined by Welch Two Sample t-test. The gender distribution was also examined. Among the participants who underwent Cold Lateral Condensation, 59 (45.38%) were female and 71 (54.62%) were male. In the Obura II group, there were 65 (50.00%) females and 65 (50.00%) males. The

difference in gender distribution between the two groups was not statistically significant (p=0.46).

The obturation technique used in the study was evaluated across different tooth types, including lower anterior, lower premolar, upper anterior, and upper premolar. For the lower anterior tooth type, 11 cases (8.46%) were treated using the cold lateral technique, while 6 cases (4.62%) were treated using the Obtura II technique. In the case of lower premolars, 34 cases (26.15%) were treated using the cold lateral technique, while 35 cases (26.92%) were treated using the Obtura II technique. For upper anterior teeth, 40 cases (30.77%) were treated using the cold lateral technique, while 52 cases (40.00%) were treated using the Obtura II technique. Lastly, among upper premolars, 45 cases (34.62%) received treatment using the cold lateral technique, whereas 37 cases (28.46%) were treated using the Obtura II technique. There was no statistically significant difference between the two techniques for tooth type (p=0.28). (Figure-1)

Table-3 presents a comparison of obturation quality between two techniques: Cold Lateral Condensation and Obtura II system. Regarding the extension of obturation, the majority of cases in both groups achieved optimum extension. In the Cold Lateral Condensation group, 113 cases (86.92%) had optimum extension, while in the Obtura II group, 114 cases (87.69%) achieved the same. A statistically significant difference was observed between the groups for extension (p=0.033) based on Pearson's Chi-squared test. In terms of extension quality, a small proportion of cases were either over extended or under extended.

In the Cold Lateral Condensation group, 4 cases (3.08%) were over extended and 13 cases (10.00%) were under extended. In the Obtura II group, 11 cases (8.46%) were over extended, and 5 cases (3.85%) were under extended. Although the difference in extension quality was not statistically significant, it is worth noting the higher incidence of overextension in the Obtura II group. Regarding the presence of voids, the Cold Lateral Condensation group had 104 cases (80.00%) with no voids, while the Obtura II group had 121 cases (93.08%) without voids. A statistically significant difference was observed between the groups for the presence of voids (p=0.004).

Table-1: Characteristics of the study participants in terms of age and gender

Variable	Characteristic	N=260
Age	mean±SD	34.58±10.86
Gender	female	124 (47.69)
	male	136 (52.31)
Age group	18–30	119 (45.77)
	31–45	95 (36.54)
	46–60	46 (17.69)

Table-2: Characteristics of the study participants according to the obturation technique (Cold lateral condensation and Obura II)

Characteristic	Cold Lateral Condensation, N=130	Obura II, N=130	*p*-value
Age, Mean ± SD	33.79±11.25	35.38±10.43	0.24*
Gender, n (%)			0.46**
Female	59 (45.38)	65 (50.00)	
Male	71 (54.62)	65 (50.00)	

*Welch Two Sample t-test; **Pearson's Chi-squared test

Table-3: Comparison of obturation quality between cold lateral condensation and Obtura II system

Characteristic	Cold lateral condensation, N=130	Obtura II, N=130	*p*-value*
Extension			0.033
Optimum	113 (86.92)	114 (87.69)	
over extended	4 (3.08)	11 (8.46)	
under extended	13 (10.00)	5 (3.85)	
Voids			0.004
Absent	104 (80.00)	121 (93.08)	
Present	26 (20.00)	9 (6.92)	

*Pearson's Chi-squared test

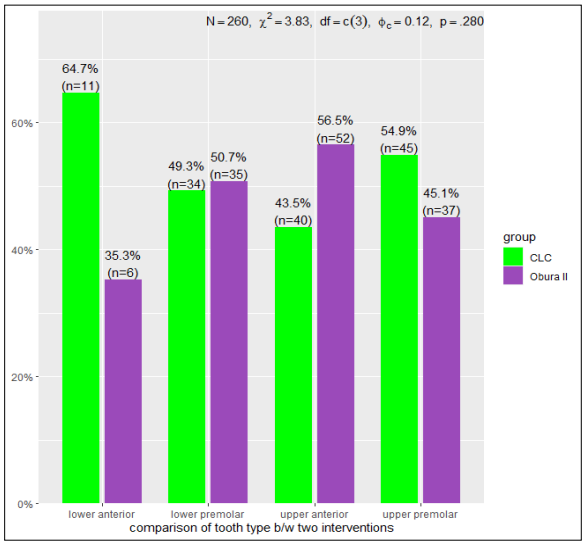

Figure-1: Comparison of tooth type between cold lateral condensation and Obtura II

DISCUSSION

Our findings showed that regarding the extension of obturation, both groups showed a majority of cases achieving optimum extension. The difference between the two techniques for extension was statistically significant, indicating variations in the effectiveness of the techniques in achieving optimal extension. In terms of extension quality, there were a small number of cases in both groups that were either overextended or underextended, with a higher incidence of overextension observed in the Obura II group, although this difference was not statistically

significant. The presence of voids showed a significant difference between the two groups, with the Cold Lateral Condensation group having a lower proportion of cases with voids compared to the Obura II group.

Several methods have been utilized to evaluate the sealing efficacy of root canal filling materials and associated obturation techniques at the apex. These methods encompass bacterial penetration tests, dye penetration tests, electrochemical leakage tests[14], radioactive isotope studies, and scanning electron microscopic analysis[15]. Among these techniques, dye penetration studies are widely employed; however, published findings indicate significant variations in the results, as evidenced by large standard deviations.[14,16] Our study was in-vivo and we utilized plain radiographs with magnification to evaluate the presence of voids and the extent of gutta percha extension. This approach allowed us to assess these factors without invasive procedures. Moreover, the use of plain radiographs with magnification provided a non-invasive method for evaluation, minimizing the potential risks associated with radiation exposure.

In a comparative trial of obturation techniques, it was found that Obtura II demonstrated superior adaptation and fewer voids compared to the other group. Specifically, the lateral condensation group exhibited a higher incidence of voids in comparison to Obtura II, with most of the voids observed at the periphery.[17] The superiority of Obtura II over lateral condensation in terms of adaptation is particularly significant, as it ensures a more reliable and durable obturation, reducing the chances of recurrent infections or other complications associated with incomplete or inadequate root canal fillings.

Obtura II is a specialized technique for obturation, or filling, of root canals in dentistry. It involves the use of an injectable material called gutta-percha, which is thermoplasticized to ensure optimal adaptation to the intricate three-dimensional root canal system. The findings from multiple studies have consistently demonstrated that Obtura II exhibits significant superiority over lateral condensation in terms of its adaptability and effectiveness in filling root canals.[18–20]

However, contradictory findings also reported in literature. A previous study compared radiographic quality of molar tooth fillings using two techniques: cold lateral condensation and the Obtura II system. Sixty patients were assigned to either technique. Radiographs were taken immediately after filling. An independent observer analyzed the radiographs, finding no significant differences between groups in tooth type, preoperative diagnosis, and pain ($p>0.05$). However, the Obtura II group had more cases of preoperative radiolucency ($p<0.05$). Postoperative outcomes, including voids and filling termination, showed no significant differences between groups ($p>0.05$).[10] Another study on including 60 patients comparing voids in Obtura II and lateral condensation and reported that difference was not significant.[21] Another study assessed sealing ability of Obtura II and lateral condensation using dye(1% methylene blue) penetration technique and reported no significant difference.[17]

A study focused on testing two sealant systems, cold laterally compacted gutta-percha, and Obtura II, with extraction using two apically separated rotational nickel-titanium files (RACE and K3). When it came to obturation, the Obtura II method was used. Their results showed that in terms of the obturated groups, it was observed that Obtura II-obturated groups had less leakage than those treated with the lateral condensation approach, even when the cracked NiTi rotary system was not present. These results showed that Obtura II has better sealing ability. However this study was in vitro.[22]

CONCLUSION

The findings suggest that Obtura II exhibits a denser sealing and fewer voids compared to the cold lateral condensation technique. However, it is worth noting that Obtura II showed a slightly higher tendency to extend beyond the apex compared to the cold lateral condensation technique. Obtura II should be used with caution to avoid irritation of peri-apical area.

AUTHORS' CONTRIBUTION

SA: Conceptualization of the study design, data collection, data analysis, data interpretation, write-up. SAK: Conceptualization of the study design, revision, final approval. AW: Data collection, write-up. SE: Write-up, proof reading. AA: Data collection, data analysis, data interpretation. AH: Proofreading, revision.

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