

# Evaluation and Comparison of Apical Sealing Ability of Three Different Obturation Methods - Warm Lateral Condensation, Warm Vertical Condensation and Cold Lateral Condensation- An In-Vitro study

## Abstract

**Introduction:** The endodontic treatment aims to recovery and to maintenance dental elements, which have pulp or endodontic periapical pathology, eliminating the microorganisms of the root canal and preventing infections. At the end of the endodontic treatment, the aim is a three-dimensional obturation of the root canal system after completion of sanitization and shaping, allowing a hermetic sealing of the entire working length and preventing infections, percolation and microleakage of exudate favoring biological repair. A good apical seal is one of the criteria for the success of the endodontic treatment. The purpose of this study was to evaluate and Compare Apical Sealing Ability of three different Obturation Methods - Warm Lateral Condensation, Warm vertical condensation and Cold lateral condensation. **Material and Methods:** The present in vitro study comparing the apical sealing ability of three obturation techniques was conducted in the department of Conservative Dentistry and Endodontics, SDMCDS, Dharwad. The sealing ability of 3 obturation methods was studied under a scanning electron microscope at the Indian Institute of Science, Bangalore. **Results:** Warm lateral condensation technique was found superior especially at apical 1/3<sup>rd</sup> when compared to other groups, which was proved statistically. The sealing ability at the coronal 1/3<sup>rd</sup>, middle 1/3<sup>rd</sup> and the apical 1/3<sup>rd</sup> was 3.94±1.04, 5.44±0.67 and 0.87±0.21 respectively. **Conclusions:** It was concluded from our study that Warm lateral condensation technique was found superior when compared to other techniques at the apical 1/3<sup>rd</sup> region.

## Key Words

Apical sealing ability; obturation; warm lateral condensation bite

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## INTRODUCTION

The complete obturation of the root canal system and the creation of a fluid-tight have been proposed as goals for successful endodontic treatment.<sup>[1]</sup> It has been determined that approximately 60% of endodontic failures are due to inadequate obturation of the root canal system.<sup>[2]</sup> Such failures have been attributed to penetration of substances from the

apical tissues into the canal. Additionally, failure could be caused by irritants left in the canal that may seep out through an inadequate seal into the periapical tissues.<sup>[3]</sup> Root canal filling or obturation is an integral component of root canal therapy. The purpose of obturation of the prepared root canal space is to prevent coronal leakage and bacterial contamination, seal the apex from the periapical

tissue fluids, and also seal the remaining irritants in the canal.<sup>[4]</sup> A plethora of laboratory studies can be found in literature; and, in contrast, clinical studies are scanty. The laboratory studies can be carried out with the objective of comparing the sealing ability and adaptation of the guttapercha points under virtual conditions, which is easier as compared to carrying out the study in a patient's mouth. This explains why the former are higher in number. Clinical trials in comparison are more challenging as they require long term follow up and objective assessment is more difficult. However, inspite of these limitations, clinical trials provide more useful and provide practical information for clinically relevant decision making.<sup>[5]</sup> The purpose of the study was to evaluate and compare Apical Sealing Ability of three different Obturation Methods - Warm Lateral Condensation, Warm vertical condensation and Cold lateral condensation.

#### MATERIALS AND METHODS

The present in vitro study comparing the sealing ability of three obturation techniques was conducted in the department of Conservative Dentistry and Endodontics, SDMCDS, Dharwad. The sealing ability of 3 obturation methods was studied under a scanning electron microscope at the Indian Institute of Science, Bangalore.

Criteria for selection of teeth:

1. Non-carious teeth
2. Straight roots
3. Closed apex

The teeth were stored in 10% formalin solution. They were cleaned using 20% H<sub>2</sub>O<sub>2</sub> to remove soft remaining tissue surrounding the teeth. The crowns of the teeth were removed at cement-enamel junction before access opening. After pulp tissue removal with broach, number 15 K- file was introduced into the canal of each specimen until it was seen just near the foramen. The working length was determined by subtracting 1mm from this length. The canals were prepared using circumferential filing with the apical matrix formed with the no. 50 file. After drying the canals thoroughly with paper points, zinc oxide powder and eugenol were taken on a clean, dry glass slab and mixed according to the manufacturer's instructions. The mixed material was placed in the root canal with the help of a lentulospiral to apply a thin coat on the walls of the canal. The teeth were divided into control group and experimental group, the first groups of 6 teeth were used as control group and second group of 30 teeth were used as the

experimental group. In control group single cone method was used. The experimental groups were divided into three groups namely, Cold lateral condensation (Group A), Warm Lateral Condensation (Group B) and Warm vertical condensation (Group C). **Warm lateral condensation:** After placing the master cone to its proper depth, a cordless, rechargeable, battery operated GP heat condenser, ENDOTEC (Caulk, Dentsply) was used to provide uniform heat to the gutta percha mass. The heat condenser tip which was introduced alongside the master GP cone was with an ordinary spreader. After switching the activator button on, the condenser was gently forced apically and laterally into the canal with the rotary penetrating motion. It was placed for 6-15 seconds and then space just created by the condenser tip. The same procedure was repeated until the canal was completely filled. **Warm vertical condensation:** For this technique various hand held pluggers were used. Three pluggers, whose diameter were just slightly less than that of the canal preparation at any level were selected for working on the coronal, middle and apical one third of the canal. Following sealer placement and master cone insertion, a spreader was heated in a glass sterilizer and allowed to plunge 3-4 mm into the apical most extent of GP and was allowed to remain there till it began to cool, afterwards it was removed and the largest prefitted plugger used to vertically pack the GP mass apically. The procedure was repeated till the canal was fully fitted. **Cold lateral condensation:** The apical portion of the master gutta percha cone was coated with sealer and inserted slowly and gently into the canal to the measured length. A hand held spreader was inserted slowly and gently into the canal to the measured length. A hand held spreader was inserted apically alongside the master cone, wedging it against the canal wall and creating space for additional cone. The process was repeated several times until the wedged cones blocked further access to the canal. The protruding butt ends of the cones were removed with the blade and of the spreader instrument heated hot and GP mass was firmly condensed. The teeth were sectioned horizontally in three sections (coronal, middle and apical) with diamond disc. Sectioned parts were coated with 20 mm of gold palladium. They were later mounted on aluminum studs and were examined under Scanning Electron Microscope (SEM).

**Table 1: Analysis between the three obturation techniques for the sealing ability at the apical 1/3<sup>rd</sup>**

| Source of variation | Sum of squares | Degree of freedom | Mean sum of squares | Variation rate | p-value |
|---------------------|----------------|-------------------|---------------------|----------------|---------|
| Between groups      | 80.57          | 2                 | 40.28               | 48.63          | <0.001  |
| Within groups       | 22.37          | 27                | 0.83                |                |         |
| Total               | 102.93         | 29                |                     |                |         |

**Table 2: Significant difference in the sealing ability between individual techniques**

| Obturation techniques         | Sealing ability ( $\mu\text{m}$ ) |      |      | F- value*        | S.D.** | Difference between groups |
|-------------------------------|-----------------------------------|------|------|------------------|--------|---------------------------|
|                               | Range                             | Mean | S.D. |                  |        |                           |
| A) Warm lateral condensation  | 0.48-1.24                         | 0.87 | 0.21 | 48.63<br>p<0.001 | 1.30   | A-B<br>p<0.01             |
| B) Warm vertical condensation | 1.76-4.75                         | 3.50 | 0.92 |                  |        | A-C<br>p<0.01             |
| C) Cold lateral condensation  | 2.50-6.04                         | 4.81 | 1.26 |                  |        | B-C<br>p<0.01             |

\*One factor ANOVA

\*\*Least significant difference

**Table 3: The sealing ability of warm lateral condensation at the coronal 1/3<sup>rd</sup>, middle 1/3<sup>rd</sup> and the apical 1/3<sup>rd</sup>**

| Region      | Warm lateral condensation |
|-------------|---------------------------|
| Coronal 1/3 | 3.97±1.04                 |
| Middle 1/3  | 5.44±0.67                 |
| Apical 1/3  | 0.87±0.21                 |

## RESULTS

In this in vitro study maxillary central incisors were chosen with single patent canals. They were obturated using three different techniques. ANOVA analysis was done between the three obturation techniques for the sealing ability at the apical 1/3<sup>rd</sup> and it was found out that there was significant difference ( $F=48.63$  and  $p<0.001$ ) [Table 1]. Further to find out the significant difference in the sealing ability between individual techniques F test was performed. The results of F test are as follows [Table 2]:

1. Between warm lateral condensation and warm vertical condensation the mean difference was 0.87 and 3.50 ( $p<0.01$ ) which was significant.
2. Between warm lateral condensation and cold lateral condensation the mean difference was 0.87 and 4.81 ( $p<0.01$ ) which was significant.
3. Between warm vertical condensation and cold lateral condensation the mean difference was 3.50 and 4.81 ( $p<0.01$ ) which was significant.

Warm lateral condensation technique was found superior especially at apical 1/3<sup>rd</sup> when compared to other groups, which was proved statistically. The sealing ability at the coronal 1/3<sup>rd</sup>, middle 1/3<sup>rd</sup> and the apical 1/3<sup>rd</sup> was 3.94±1.04, 5.44±0.67 and 0.87±0.21 respectively [Table 3].

## 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.<sup>[6]</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.<sup>[7]</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>[8]</sup> It would seem safe to assume that noxious products leaking from the apical foramen acts as an inflammatory irritants.<sup>[9]</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. Matloff *et al.*,<sup>[10]</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. In case of Thermafil obturating technique during the study as well as radiographically maximum specimen showed extrusion of the sealer.<sup>[6,11,12]</sup> The present study has shown that Warm lateral condensation technique was found superior especially at apical 1/3<sup>rd</sup> when compared to other groups. The results of this study can be correlated with the previous studies.<sup>[12,13]</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>[14]</sup> In a study,<sup>[15]</sup> the ability of filling the lateral canals was tested, it was observed that thermoplastic techniques generate a better filling of these than lateral condensation. According to a study,<sup>[16]</sup> to an increase in successful endodontic treatment, the root canal system should be effectively sealed at the coronal and apical region being the apical sealing the main barrier to infiltration. In their study comparing three obturation techniques, there were better results in the techniques of heated Gutta-percha compared to cold lateral condensation techniques, with no significant differences between the techniques of Gutta-percha heated.

### CONCLUSIONS

It was concluded from our study that Warm lateral condensation technique was found superior when compared to other techniques at the apical 1/3<sup>rd</sup> region. However, further studies a need to be conducted in this regard.

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