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Original Research

Comparison of Efficacy of Different Obturation Techniques used in Root Canal Treatment

Dr. Dal Singhar Singh[1], Dr. Raghunandini Batra[2]

[1]B.D.S
[2]B.D.S

Abstract

Aim: This research sought to assess the proportion of gutta-percha-filled area (PGFA) within root canals that were filled utilizing the Thermafil technique, Warm Vertical Condensation technique (WVC), or Cold Lateral Condensation technique (CLC), all without the use of sealers. To facilitate this evaluation, cross-sectional analyses of the root canals were performed through microscopic examination.

Materials and methods: A total of 90 permanent teeth featuring single roots were extracted for this study. The teeth were sectioned at the coronal level and randomly divided into three separate groups, each comprising 30 samples. The classification of these groups was based on the obturation techniques applied. Group A was treated with the Thermafil obturation method, Group B utilized warm vertical condensation, and Group C employed cold lateral condensation. The obturation processes were carried out using specific methodologies without the inclusion of sealers. Following the obturation, the teeth were horizontally cross-sectioned approximately 2 to 3 mm from the apex using a double-sided diamond disc. The resulting sections were visually recorded and analyzed with a stereomicroscope at a magnification of 50x. Measurements of the canal dimensions and the gutta-percha were conducted using KS 100 imaging equipment, and the area filled with gutta-percha (PGFA) was calculated. Statistical analysis of the data collected was performed using ANOVA and the Student's t-test.

Results:Group A, particularly the Thermafil group, demonstrated a markedly elevated mean value when contrasted with both research groups II and III. In a similar vein, group B, which implemented WVC, showed a significantly higher mean value relative to group C, which utilized CLC. Consequently, the differences noted among the various groups were statistically significant.

Conclusion: The current research indicates that both the warm vertical condensation method and the cold lateral condensation technique result in notably lower percentages of gutta-percha filled area (PGFA) when contrasted with the Thermafil Obturation method.

Keywords: obturation, root canal, thermafil

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Corresponding author: Dr.Dal Singhar Singh, B.D.S

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Introduction

Effective obturation is a critical component of successful endodontic therapy. The cleaning and shaping of the root canals play a vital role in ensuring thorough debridement and the elimination of residual tissue, which is a fundamental aspect of endodontic procedures.[1] Nevertheless, insufficient filling can compromise the efficacy of root canal treatment. Poorly executed endodontic filling is associated with the onset of periapical pathology and is regarded as a failure in endodontic care. In a systematic review conducted by Ng et al., four key factors were identified that significantly enhance the success rates of primary root canal treatments, one of which is the presence of a root filling devoid of voids.[2,3]

An insufficient root filling is one of several contributing factors.[4] Research has shown that bacteria play a significant role in the failure of endodontic treatments.[5,6]
Hence, this study had been carried out to assess the Comparison of Efficacy of Different Obturation Techniques used in Root Canal Treatment.

Material and methods
A total of 90 permanent teeth featuring single roots were extracted for this study. The teeth were sectioned at the coronal level and randomly divided into three separate groups, each comprising 30 samples. The classification of these groups was based on the obturation techniques applied. Group A was treated with the Thermafil obturation method, Group B utilized warm vertical condensation, and Group C employed cold lateral condensation. The obturation processes were carried out using specific methodologies without the inclusion of sealers. Following the obturation, the teeth were horizontally cross-sectioned approximately 2 to 3 mm from the apex using a double-sided diamond disc. The resulting sections were visually recorded and analyzed with a stereomicroscope at a magnification of 50x. Measurements of the canal dimensions and the gutta-percha were conducted using KS 100 imaging equipment, and the area filled with gutta-percha (PGFA) was calculated. Statistical analysis of the data collected was performed using ANOVA and the Student's t-test.

Results
Table 1 illustrates the mean percentage of gutta-percha filled area within the apical third of root canals, as assessed through the Thermafil, WVC, and CLC techniques. The findings indicate that group A, which implemented the Thermafil technique, exhibited the highest average PGFA. Conversely, group B, utilizing the WVC technique, recorded the second highest mean PGFA. In comparison, group C, which applied the CLC technique, demonstrated the lowest PGFA percentage.

Table 1: Mean percentage of gutta-percha filled area in different study groups

Group	Number of samples	Mean
Group A	30	88.59
Group B	30	85.24
Group C	30	79.55

Table 2: Between group comparisons of percentage of gutta-percha filled area in different groups

Comparison	Mean difference	P-value
Group A vs Group B	1.204	<0.001
Group A vs Group C	3.558	
Group B vs Group C	5.638	

Group A, which utilized the Thermafil technique, demonstrated a markedly higher mean value when compared to both research groups II and III. In a similar vein, group B, which applied the WVC technique, showed a considerably elevated mean value relative to group C, which employed the CLC technique. Consequently, the differences noted among the various groups were statistically significant.

Discussion
The process of filling root canals, known as obturation, represents a vital component of effective root canal treatment (RCT). The primary objectives of obturation are to establish an apical seal and to fill the root canal completely, ensuring that no voids are present within the filling material. Successful obturation is essential for preventing the ingress of contaminants, including saliva, bacteria, and periapical tissue fluid, into the canal, while also trapping any remaining microorganisms within the canal space.[7]
The effectiveness of root canal obturation is closely linked to the prior phase of cleaning and shaping. This phase involves the mechanical and chemical preparation of the root canal to eliminate both organic and inorganic debris. Inadequate cleaning and shaping will lead to suboptimal obturation, which is a significant predictor of treatment failure.[8]
Root canals exhibit intricate and distinct three-dimensional structures, with each canal presenting a unique anatomical configuration. For enduring success in endodontic treatment, it is crucial to achieve a three-dimensional obturation that ensures complete sealing at the coronal, lateral, and apical levels. Radiographic imaging remains the primary technique for visualizing root canals throughout both the diagnostic and therapeutic phases.[9] Nonetheless, a significant limitation of this method is its provision of only a two-dimensional view of inherently three-dimensional canal systems. Consequently, evaluating the quality of the canal seal established during the obturation process becomes unfeasible. The advent of micro-computed tomography (micro-CT) in endodontics has significantly improved the precision of diagnosis, cleaning, shaping, and ultimately, the obturation process.[10]
The findings of this research demonstrate that Group A (Thermafil) displayed a markedly elevated mean value relative to both Group II and Group III. Furthermore, Group B (WVC) showed a significantly

greater mean value in comparison to Group C (CLC). Consequently, the differences noted among the various groups were statistically significant.

Canakci et al.[11] conducted a study to assess the volume of debris extruded apically from root canals filled using two different techniques: cold lateral condensation (CLC) and warm vertical compaction (WVC). The materials employed included either b or a phase gutta-percha in conjunction with AH-Plus (Dentsply DeTrey, Konstanz, Germany) or Resilon (Resilon Research LLC, Madison, WI) paired with RealSeal SE (SybronEndo, Amersfoort, The Netherlands). A total of 100 human incisor teeth were prepared utilizing a #25.06 NiTi rotary system and categorized into five distinct groups based on the filling material: Group 1 utilized CLC with gutta-percha and AH-Plus; Group 2 employed WVC with b phase gutta-percha and AH-Plus; Group 3 used WVC with a phase gutta-percha and AH-Plus; Group 4 applied CLC with Resilon and RealSeal SE; and Group 5 implemented WVC with Resilon and RealSeal SE. During the retreatment process, extruded debris was collected in preweighedEppendorf tubes, and the duration of the retreatment was recorded. The findings indicated that the amount of debris extruded was significantly higher in the WVC groups compared to the CLC groups for both gutta-percha and Resilon ($P < 0.001$). Additionally, the use of a phase gutta-percha resulted in a significantly greater volume of debris extrusion compared to b phase gutta-percha ($P < 0.001$). In the WVC groups, Resilon was associated with significantly more debris extrusion than gutta-percha ($P < 0.05$). Furthermore, the retreatment duration was shorter for CLC compared to WVC ($P < 0.05$).

Gupta et al.[12] conducted a comparative analysis of three distinct root canal obturation methods: lateral compaction, Thermafil, and Calamus, utilizing cone beam computed tomography for assessment. The study involved a selection of 30 central incisors, which underwent biomechanical preparation using a Reciproc file size 25. The specimens were categorized into three groups, each comprising 10 teeth, based on the obturation technique employed—Calamus, Thermafil, and lateral compaction. Cone beam computed tomography facilitated the evaluation of the filling area and the presence of voids in the coronal, middle, and apical thirds of the root canal post-obturation. Statistical analysis was performed using One-Way ANOVA and Tukey HSD multiple comparison tests. The findings indicated that the Calamus group exhibited the highest volume of obturating material, followed by the Thermafil and lateral compaction groups. Additionally, the Calamus technique demonstrated the least amount of voids. Despite the study's limitations, it was concluded that Calamus may represent an effective obturation technique.

Conclusion

This research indicates that both the warm vertical condensation method and the cold lateral condensation technique result in notably lower percentages of gutta-percha filled area (PGFA) when contrasted with the Thermafil Obturation method.

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