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Comparative Evaluation of Apical Sealing Ability of Gutta Percha Using Different Obturating Techniques: An Ex-Vivo Study under UV-Visible Spectrophotometer

Dr. Sumedha Sumbria[1], Dr. Asheesh Sawhny[2], Dr. Karuna Sawhny[3], Dr. Saurabh Sharma[4]

[1]Consultant Endodontist, Jammu, Jammu & Kashmir, India (Corresponding Author)

[2]Professor & Head, Department of Conservative Dentistry & Endodontics, Rama Dental College, Hospital & Research Centre, Kanpur, UP, India

[3]Professor, Department of Orthodontics & Dentofacial Orthopaedics, Rama Dental College, Hospital & Research Centre, Kanpur, UP, India

[4]Senior Lecturer, Department of Conservative Dentistry & Endodontics, Rama Dental College, Hospital & Research Centre, Kanpur, UP, India

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KEYWORDS

Gutta Percha, Microleakage, warm vertical condensation, cold lateral compaction and single cone technique.

ABSTRACT:

Aim: Aim of this study is to evaluate the apical sealing ability of different obturating techniques using warm vertical condensation, cold lateral condensation & single cone technique, using resin-based sealer using dye extraction method under UV visible spectrophotometer.

Material and Methods: Freshly extracted sixty single-rooted teeth were collected & stored in 3% sodium hypochlorite solution for 1 week. The canal orifice was located using DG-16 and the working length was determined by placing a #10 K-file Root canals were then prepared using crown-down technique with endomotor and rotary ProTaper Gold files. The samples were then randomly divided into 3 groups of 20 teeth each. The groups were named: Group A: Warm vertical condensation obturation technique, Group B: Cold lateral condensation technique, Group C: Single cone technique.

Results: Statistical analysis was carried out one way ANOVA test to determine whether there were significant differences among the groups. Post hoc and Student 't' test were performed to know the effect of each variable and to reveal the statistical significance. The confidence level of study was proposed to be 95% hence p-value < 0.05 has been considered significant. Mean comparison of microleakage among Warm Vertical Compaction, Cold Lateral Compaction and Single Cone Technique are compared. The mean leakage scores were as follows; 0.548 ±0.016 in Group A, 0.745± 0.012 in Group B & 0.885 ±0.013 in Group C.

Conclusion: The present study indicated minimal apical leakage in warm vertical condensation technique, followed by cold lateral technique, and most in single cone technique with mean values of 0.548 ± 0.016, 0.075 ±0.012 & 0.0885 ±0.013 respectively.

Introduction

Root canal filling's two main objectives are to completely fill the canal space with a stable, nontoxic substance and to seal it off to prevent the passage of bacteria, bacterial byproducts, or tissue fluids through the filled canal.[1] Obturation creates a seal that guards against the canal being reinfected and subsequent leaking into the surrounding tissues.[2] One approach's shortcomings have frequently spurred the creation of new obturation techniques over time, as well as the realization that no one obturation technique may be effective in every clinical situation. It has been established that the filling technique via lateral compaction of gutta-percha is very well-liked and therapeutically successful. Schilder, however, observed that final filling by lateral consideration produced a non-homogeneous mass of several isolated gutta-percha cones that were forced together and only connected by friction and the cementing ingredient.[3]Although the cold lateral compaction method works best in properly tapered canals, imperfections in the morphology or taper may increase voids or sealer pooling.[4] Since Schilder first proposed the warm vertical gutta-percha compaction filling

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approach as an alternative to lateral condensation, several in vitro investigations contrasting the warm gutta-percha vertical compaction filling technique with other filling techniques have demonstrated its superiority.[5] However, it has also been demonstrated that an inconsistent temperature rise occurs in the apical gutta-percha when using flame-heated carriers in a wide canal.[6] However, using the vertical compaction approach may be more challenging and time-consuming, particularly when incrementally backfilling the coronal portion of the root canal.[7] A recently introduced configuration of gutta-percha point has the same taper as the final ProTaper Finisher instrument (Dentsply Maillefer, Ballaigues, Switzerland). This technique uses larger master cones that best match the geometry of the nickel-titanium rotary systems (NiTi).[8] The use of these gutta-percha points does not require either accessory points or lateral condensation when the root canal is enlarged with rotary instruments.The combination of single cone and endodontic cement results in a uniform mass that prevents failures observed among multiple cones.[9] Hence, the purpose of this study is to assess the apical sealing ability of gutta-percha using three different techniques (warm vertical, cold lateral & single cone) using UV-Spectrophotometer.

Aims & Objectives

Aim of this study is to evaluate the apical sealing ability of different obturating techniques using warm vertical condensation, cold lateral condensation & single cone technique, using resin-based sealer using dye extraction method under UV visible spectrophotometer.

Materials & Methods

This was an ex-vivo study & single-rooted human teeth were used.Freshly extracted sixty single-rooted teeth (incisors & canines) were collected from the Department of Oral and Maxillofacial Surgery of Rama Dental College, Hospital & Research Centre.All teeth were analyzed using digital radiography to confirm non-complicated root canal anatomy and single canals. The Institutional Ethical Committee and the Scientific Committee both gave their approval for this project to proceed. Inclusion Criteria: single-rooted teeth with almost straight canal, roots with mature apices, sound teeth with no fractures and cracks. Exclusion criteria: root with caries, calcified or obliterated canals, previously root canal-treated teeth, presence of multiple canals in the teeth, developmental anomalies.

Figure 1: Teeth with Single Canal

Methods

Freshly extracted sixty single-rooted teeth were collected & pre-operative radiographs were taken to confirm the presence of a single canal and to rule out any exclusion criteria. The collected teeth were stored in 3% sodium hypochlorite solution for 1 week for dissolution of organic debris. The teeth were then immersed in 10% formalin solution for 5 days for complete disinfection of the teeth. Standard access cavities were made using airotor and endo-access bur in all the sample teeth. The canal orifice was located using DG-16 and the working length was determined by placing a #10 K-file till it was just seen at the apical foramen & then 1mm was subtracted from this length. The working length was recorded for each sample teeth in same way. Root canals were then prepared using crown-down technique with endomotor and rotary ProTaper Gold files (Dentsply Maillefer, Switzerland) with full sequence of SX, S1, S2, F1 till size F2 (at 300 rpm & 2 N.cm Torque). After each file, copious irrigation with 5.25% sodium hypochlorite was done with 27-gauge needle & RC Prep was used as a lubricant. This was followed by a rinse of 3 ml of 17% aqueous EDTA for 1 minute. Upon completion of instrumentation, the canals were dried using paper points (F2 MetaBiomed) and the samples were then randomly divided into 3 groups of 20 teeth each. The groups were named: Group A: Warm vertical condensation obturation technique, Group B: Cold lateral condensation technique, Group C: Single cone technique.

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Group A: Warm Vertical Obturation Technique

A non-standardized gutta-percha cone (Fine/Fine-Medium, Diadent) was checked for tugback, confirmed radiographically & was kept 0.5 mm short of the full working length. Pre-fitting of pluggers were done. Wide plugger was used for coronal third, medium sized plugger was used for middle third & narrow sized plugger was used for apical third. AH Plus Sealer was used. It was mixed on a paper mixing pad using metal spatula, until homogenous consistency was achieved, as instructed by manufacturer. The trimmed GP cone, lightly coated with sealer was placed into the canal. At the level of the cemento-enamel junction, the GP was seared off with the tip of an activated heat carrier 150^0C (Woodpecker Fi-Pen). This transferred the heat to coronal third of gutta-percha cone and created a platform to begin the first wave of compaction. Using the wide plugger, the gutta-percha was folded into a mass & compacted in apical direction with sustained 5-10 second pressure. This was the first heat wave. The second heat wave begun by inserting the tip of an activated heat carrier at 200^0C into the gutta-percha where it remains for 2-3 seconds & when retrieved it carried with itself the first selective gutta-percha segment. Immediately the medium sized plugger was used to compact & exert the apical & lateral pressure. The second heating of activated heat tip warmed the next 3-4mm of gutta-percha and again an amount was removed from the end of tip. The narrowest plugger was immediately inserted in the canal & the surplus material along the walls was folded into apical mass & the material flowed into & sealed the apical portals of exit. For back-packing of the remainder canal, pre-cut segments of α gutta-percha were placed inside the obturating gun (Woodpecker Fi-Gun) and were heated to 200^0C. The plasticized gutta-percha was injected into the canal and was then compacted with pluggers to ensure its flow against canal walls and to minimize shrinkage.

Group B: Cold Lateral Compaction Technique

Spreader selection was done such that the finger spreader was short of working length by 2mm and was neither too loose nor did it bind in the canal. AH Plus Sealer was used. It was mixed on a paper mixing pad using metal spatula, until homogenous consistency was achieved, as instructed by manufacturer. An ISO 0.2% gutta-percha cone size #30 was inserted into the root canal to full working length & was checked for tug-back and confirmed radiographically. Gutta-percha cone was coated with sealer and seated in the root canal. Finger spreader and accessory gutta-percha cones were used for lateral condensation. Cones were added until the spreader didn't penetrate beyond the coronal third of the canal. Excess gutta percha was seared off with a heat activated tip at 150^0C (Woodpecker Fi-Pen).

Group C: Single Cone Technique

AH Plus Sealer was used. It was mixed on a paper mixing pad using metal spatula, until homogenous consistency was achieved, as instructed by manufacturer. A single gutta-percha cone (F2, Dentsply Maillefer) that matched the taper and size of the final rotary instrument was checked for tug-back and confirmed radiographically. The cone was coated with sealer and inserted into the canal. Excess gutta percha was seared off with a heat activated tip at 150^0C (Woodpecker Fi-Pen). After completion of obturation in all the sample teeth, the access openings were etched (36% phosphoric acid etching gel) for 15 seconds. This was followed by rinsing the area with water spray for 15 seconds. The bonding agent was applied using micro-applicator and was cured for 15 seconds at 800 mW/cm2 intensity. Composite restoration was done in increments of 1-1.5mm and each increment was light cured 15 seconds at 800 mW/cm2 intensity. This was done to achieve a complete seal of obturation and avoid penetration of dye in that area. Upon completion of the filling process, all samples were stored in saline at room temperature for 48 hours. After 2 days, the root surfaces of samples were covered with 2 layers of nail varnish with fine brush, except apical 2 mm which was measured using metallic scale, where dye penetration was needed. The samples were then placed in 2% methylene blue dye solution for 3 days at room temperature. After 3 days, samples were then washed under running tap water to remove the traces of the dye and nail varnish was removed with a scalpel. Each sample was then immersed in test tube containing 1 ml of freshly prepared 65% nitric acid for 72 hours, until complete disintegration of each teeth occurred. This solution was then transferred to effendorf tubes and centrifuged at 14,000 RPM for 5 min to separate GP debris from the extracted dye. Dye concentration in the

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supernatant solution was analyzed using UV spectrophotometer at 550 nm.

Figure 2: Armamentarium for warm vertical obturation

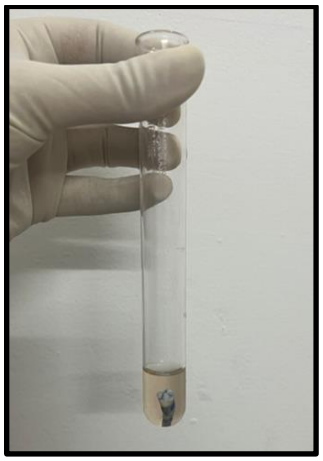

Figure 3: Tooth Immersed in 65% Nitric Acid

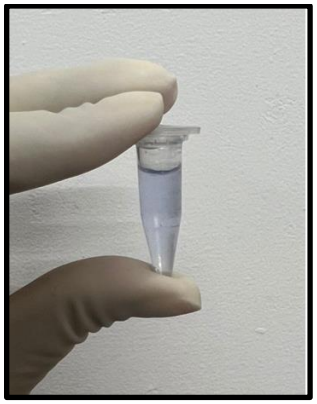

Figure 4: Eppendrof tube containing disintegrated solution of tooth & nitric acid & GP

Results

A total of 60 teeth were tested, which were randomly divided into groups of three. The 3 groups were: Group A: Warm Vertical Obturation Technique, Group B: Cold Lateral Condensation Technique, Group C: Single-Cone Technique. Statistical analysis was carried out one way ANOVA test to determine whether there were significant differences among the groups. Post hoc and Student 't' test were performed to know the effect of each variable and to reveal the statistical significance. The confidence level of study was proposed to be 95% hence p-value < 0.05 has been considered significant. Mean comparison of microleakage among Warm Vertical Compaction, Cold Lateral Compaction and Single Cone Technique are presented in Table no1. The mean leakage scores were as follows; 0.548 ±0.016 in Group A, 0.745± 0.012 in Group B & 0.885 ±0.013 in Group C. Statistical Analysis: one way ANOVA test. Statistically significant if P≤0.05. It was observed that the mean apical leakage was minimum in group A (Warm vertical condensation technique) followed by group B (Cold lateral condensation technique) while group C (Single cone technique) revealed the maximum leakage.

Groups	N	Minimum	Maximum	Mean	SD	P value
Warm Vertical Compaction	20	0.520	0.568	0.548	0.016	0.04 Significant
Cold Lateral Compaction	20	0.728	0.763	0.745	0.012	
Single Cone Technique	20	0.856	0.903	0.885	0.013	

Table 1: Mean comparison of microleakage among Warm Vertical Compaction, cold lateral condensations & single cone technique

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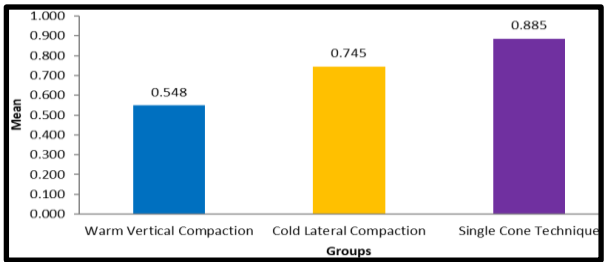

Graph 1: Bar Graph showing mean comparison of apical microleakage among 3 groups

Discussion

The complex endodontic morphology and the multitude of available obturation techniques influence the decision process and the efficiency of root fillings that keep their stability and predictability over time. The literature describes several methods and techniques for evaluating the quality of endodontic obturations, both "in vivo", but mostly "in vitro". Certain studies used optical microscopy[10], while others micro-computed tomography[11] or spectrophotometry.[12] In the present study, teeth with single canals were used in an attempt to avoid the presence of isthmus. The prepared teeth were randomly divided and obturated into the following three groups (n = 20 per group) namely warm vertical condensation, cold lateral condensation & single- cone technique. This study has used an "in vitro" method for evaluation of apical sealing ability of gutta percha using different obturating techniques in extracted teeth with single canals, and non-complex anatomy. Using the visible UV-spectrophotometry, a comparative analysis was performed between three different types of endodontic obturation techniques.

Conclusion

Within the limitations of the study, authors stated highly significant clinical inferences. They concluded that the results of this study indicated minimal apical leakage in warm vertical condensation technique, followed by cold lateral technique, and most in single cone technique with mean values of 0.548 ± 0.016, 0.075 ±0.012 & 0.0885 ±0.013 respectively.

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