



Apical microleakage in root canals obturated with lateral compaction, warm vertical compaction and Gutta-Flow techniques (in vitro study)

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Abstract

The sealing ability of root canal filling materials is crucial to the goal of preventing reinfection via microleakage of microorganisms and their by-products. Thirty palatal canals of 12mm length from extracted upper first molars were selected then instrumented and divided into 3 groups. Group I was obturated with lateral compaction technique, group II was obturated with warm vertical compaction technique and group III was obturated with Gutta-Flow system. Except for the apical 2 mm, all other segments of roots for the 3 groups received two layers of nail varnish and immersed in a methylene blue 2% and stored at 37C° for 30 days. Under stereomicroscope liner dye leakage was measured. No statistical difference was found between lateral compaction, warm vertical compaction and Gutta-Flow sealing ability.

Key words: Apical microleakage, methylene blue dye, lateral compaction, warm vertical compaction, Gutta-Flow.

Introduction

The goal of endodontic treatment is to clean, shape and fill the root canal space thoroughly to prevent apical and coronal leakage ⁽¹⁾. Gutta-percha has been used in dentistry for over 150 years, and in combination with sealers is the filling material of choice, but can be used in a variety of ways to fill the root canal system ⁽²⁾.

Cold lateral compaction is the obturation technique most widely taught in dental schools and used by practitioners, and it is still the standard to which other techniques are compared ⁽¹⁾.

In 1967, Schilder described warm vertical compaction as an alternative to cold lateral condensation with the idea

that compaction of thermoplasticized gutta-percha would permit full adaptation of the gutta-percha to the anatomical complexities of the root canal. Numerous modifications have been introduced for vertical compaction of gutta-percha ⁽³⁾ and back filling with thermoplasticized, injectable gutta-percha ⁽⁴⁾.

In 2004, Coltène Whaledent Inc.(Cuyahoga falls, Altstatten, Switzerland) introduced Gutta Flow which is a cold, flowable, self-curing obturation material for root canals that combines gutta-percha and sealer into one injectable system ⁽¹⁾. Gutta Flow contains gutta-percha in particle form, polydimethylsiloxane and silver

particles⁽⁵⁾. It is used in combination with master gutta-percha cone, the material is believed to flow into lateral canals and completely fill the spaces, no shrinkage is believed to occur, and the manufacturer report that the material expands 0.2% upon curing⁽⁶⁾ and have antibacterial properties⁽²⁾.

Considering that there are few studies analyzing the sealing capacity of this new obturation technique and due to different conclusions, the present study evaluated the marginal apical sealing capacity of Gutta Flow using methylene blue dye leakage method.

Material and Methods

Thirty extracted upper 1st molar teeth were cleaned externally, hydrated and kept stored in a 1% thymol solution in room temperature for less than one month until used. The palatal root of all teeth was cut with disk bur to obtain 12 mm long specimens. All palatal roots were viewed under three magnifications, any root having cracks or apical destruction was discarded.

The working lengths were established visually by subtracting 1 mm from the length of K-file size #15 (Dentsply Maillefer, Ballaigues, Switzerland) placed at the apical foramen. The coronal and middle thirds of each canal were prepared using Gated Glidden drills (Dentsply Maillefer, Ballaigues, Switzerland) numbers 3, 2, 1 sequentially. The apical third was prepared with flexofile (Dentsply Maillefer, Ballaigues, Switzerland) sequentially to #40 using balanced force technique.

During instrumentation procedures, 2 ml of 2% NaOCl solution was used before each file. All specimens received a final flush of 2 ml of 17% EDTA for 3 min. and 5 ml of saline solution. Then the root canals were dried with sterile paper points

(Dentsply Maillefer). The prepared teeth were randomly divided into three groups of 10 teeth each. All teeth were obturated by the same operator following manufacture's instruction.

Lateral Compaction Group: A size 40 master gutta-percha point (Dentsply Maillefer, Ballaigues, Switzerland) was fitted at the working length. The root canals were filled with lateral compaction technique with AH26 sealer using size B endodontic finger spreader (Dentsply Maillefer, Ballaigues, Switzerland) inserted 2-3 mm short of the working length, and 7-10 accessory gutta-percha points size 20 with 0.02 taper (Dentsply Maillefer, Ballaigues, Switzerland) were used until entire length of the root canal was filled and the excess of gutta-perch was removed with heated instrument.

Warm vertical compaction group: a master point was checked for fit and length, the AH 26 sealer was applied and the master cone size #40 gutta-percha point was introduced into the root canal until the working length was reached. The cordless heat-carrier pluggers (E&Q Master, Meta Biomed Co., Korea) was introduced 3-4 mm from the tip of master cone, then cutting and plugging for apical one-third obturation. Cordless gutta-percha obturation gun of the same company was used for obturation of coronal two-thirds of the root canals through injecting warm gutta-percha in back fill procedure.

Gutta-Flow Group: A size #40 master gutta-percha point (Dentsply Maillefer) was checked for fitness at the working length. The activated capsule was mixed for 30 seconds in a triturator. The tip of the Gutta Flow device was introduced into the root canal 3 mm short of the working length and Gutta-Flow was inserted. The master gutta-percha point was coated with Gutta-Flow and inserted

to the working length. By pressing the master gutta-percha point laterally, the tip of the device was inserted again into the canal to seal the back fill space. Excess gutta-percha was removed with a heated instrument.

The quality of root canal obturation of all samples was confirmed with a digital radiography taken by Kodak devise (Kodak RVG 6100, Eastman Kodak Company, France). All teeth were kept at 37C° and 100% humidity for seven days to allow setting of sealer. Except for the apical 2 mm, all other segments of roots received two layers of nail varnish. All roots were immersed in a methylene blue 2% and stored at 37C° for 30 days, after which they were thoroughly rinsed in running water. The nail varnish was removed with a scalpel blade. The roots were longitudinally sectioned in a buccolingual direction using a diamond disc on a slow speed hand piece with the aid of chisel to obtain two symmetrical halves. The degree of microleakage was determined by measuring the linear extent of methylene blue penetration from apical end of the preparation to the maximum extent in the coronal direction using a stereomicroscope at x10 magnification. To eliminate bias, apical leakage were measured independently by two evaluators, and the final values recorded were the arithmetic means of the measures obtained by the two and the result measurement were subjected to statistical analysis.

Results

The minimum and maximum values of mean and standard deviation values for each group are presented in table (1). ANOVA test table (2) showed a non significant difference between the three groups.

Discussion

The sealing ability of a root canal filling material is an important factor in preventing leakage of microorganisms and reinfection of the root canal system⁽⁵⁾. However, it has been reported that a complete seal of the root canal system is almost impossible with currently accepted materials and obturation techniques using a combination of gutta percha and root canal sealer⁽⁷⁾.

To study the sealing capacity of new filling material techniques, many methods have been employed; dye⁽⁸⁾, bacteria and their product^(9, 2) fluid transport^(10, 11) and glucose penetration⁽¹²⁾. However; it has been showed that there is non significant difference between methylene blue dye and bacterial leakage method⁽¹³⁾.

The root canals were evaluated using a sectioning technique. There are three advantages of sectioning techniques; conservation of tooth substance for further analysis, considerably less time involved and lower costs⁽¹⁴⁾.

Obturation was performed with AH26 (epoxy – resin – based sealer) in a lateral condensation group and with vertical compaction group. AH 26 have low contraction and solubility in comparison with ZOE- based and calcium hydroxide root canal sealers resulting in lower leakage⁽¹⁵⁻¹⁹⁾.

Lateral compaction was the technique of choice for the study because it is very widely used and facilitates comparison with previous studies⁽²⁾ and also dye penetration with longitudinal splitting of the root canal filling is the simplest and most commonly technique used to evaluate the sealing ability⁽²⁰⁾. According to Pommel and Camps, samples were left for a period of 30 days for more precise data⁽²¹⁾.

In this study, the result showed that there is non-significant difference in the sealing ability of lateral compaction, vertical compaction of Gutta Flow system. This finding is in accordance with Aminsobhani M. et al⁽²²⁾ who used split - chamber model in testing saliva leakage and also in accordance with Chohayeb⁽²³⁾ who used the dye leakage method and with Elias I. et al⁽¹³⁾ who found that there is no significant differences between lateral condensation and Gutta Flow system using bacterial and dye leakage methods.

Furthermore, Punia S Kappor⁽²⁴⁾ did not find any significant difference in assessment of apical microleakage between lateral condensation with AH plus and Gutta Flow with master cone. Similarly, Marciano MA,⁽¹⁾ evaluate single root canals filled using different obturation techniques and did not observe any significant difference in the sealing ability of lateral condensation and Gutta Flow in apical level.

The findings of our study showed that the sealing ability of lateral compaction, warm vertical compaction of Gutta Flow system were not significantly different, in disagreement with Rai K. et al⁽¹⁴⁾ who investigated the apical sealing ability of newer resin based pulp space sealer and showed that the Gutta-Flow system significantly higher leakage than lateral compaction, this may attributed to the using of different sealer types and different stored time.

However, Savariz A. et al⁽⁵⁾ studied the long term sealing ability of Gutta Flow versus AH plus using different obturation techniques and showed that Gutta Flow with single cone and with lateral compaction have less leakage than AH plus with single cone and with lateral compaction technique. This difference could be attributed to the capacity of Gutta Flow

to expand slightly on setting and also to the different stored time and obturation method.

Zielinski M. Tracie et al⁽⁶⁾ evaluated the Gutta Flow and gutta percha in the filling of lateral grooves and depressions and concluded that obturation with Gutta Flow flows significantly better in the apical 2mm (better seal) of split - tooth model than gutta percha placed using a warm vertical compaction technique, this difference could be result from different measurement method, different sealer and the ability of Gutta Flow to flow more than gutta percha with warm vertical compaction into grooves and depressions.

However, Monticelli F. et al⁽²⁵⁾ in his study found that the sealing ability of a warm vertical compaction is more than Gutta Flow system, this difference could be the result from different time and leakage measurement method.

Our study, also disagree with ElAyouti A. et al⁽²⁶⁾ who found that Gutta Flow system had better sealing ability than lateral compaction and with vertical compaction technique. This difference could be attributed to the more homogeneity and adaptation of Gutta Flow in the canals and also may result from different instrumentation technique and measurement methods.

Furthermore, E Pitout⁽²⁷⁾ in his study concluded that microleakage of Gutta Flow using single cone technique is similar to that of gutta percha using lateral condensation and less than that of gutta percha using vertical condensation. This difference could result from different sealer type and different stored time.

Within the limitation of this in vitro study, we can conclude that none of the obturation method can achieve complete apical seal and dye penetration of root canal obturated with Gutta Flow system is similar to

root canals obturated with lateral compaction and with warm vertical compaction using AH26 sealer.

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Table (1) Descriptive statistic for each group

Obturation Technique	Sample size	Mean	SD	Min	Max
Lateral cond.	10	2.55	0.83	1.00	4.00
Obtura II	10	1.95	0.79	1.00	3.00
Gutta-flow	10	2.10	0.56	1.00	3.00

Table (2) ANOVA test among groups

Obturation Technique	Mean	SD	F-test	P-value	Sig.
Lateral cond.	2.55	0.83	1.77	0.19	NS
Obtura II	1.95	0.79			
Gutta-flow	2.10	0.56			

NS: Non Significant at level $P > 0.05$.