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ORIGINAL ARTICLE

Comparative Analysis on Apical Microleakage in Root Canals Obturated with Gutta flow, Thermafil and Regular Guttapercha with Lateral Condensation – A Stereomicroscopic Study

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ABSTRACT:
Aims: The aim of this study was to evaluate and compare the apical microleakage of GuttaFlow in comparison with the Cold Lateral Condensation, and Thermafil obturation technique. **Settings and Design:** In-Vitro Material Science Study. **Methods and Material:** Forty five extracted human maxillary incisors with intact root were selected and crown portion removed. In all the samples access was gained and working length was determined. Biomechanical preparation was done using step back technique upto size 50 K file with copious irrigation with 5.25% sodium hypochlorite and 17% EDTA. The teeth were divided into three groups of fifteen teeth each for obturation. Group I- GuttaFlow with Master cone; Group II- Thermafil group; Group III- Cold Lateral Condensation group. Following obturation, the samples were incubated followed the application of two layers of nail polish up until the apical 2mm for all the samples. All the samples were placed in India ink dye with two thirds of the roots apically submerged in the dye for seven days. The samples were then washed in running water and sectioned vertically along the long axis, short of reaching the obturation material, creating a stress canal. A chisel was then used to split the tooth. The dye penetration was then measured using stereomicroscope. **Statistical analysis used:** In order to compare the means of the 3 groups, ANOVA was used. **Results:** Mean Apical microleakage for Thermafil group was the maximum followed by Guttaflow and Cold Lateral condensation with AH Plus sealer. However the difference was not statistically significant. **Conclusions:** The result in the present study showed that GuttaFlow provides a similar consistent seal as compared to either cold lateral compaction or Thermafil technique.
Key-words: Microleakage, Guttaflow, Thermafil, Stereomicroscope.

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INTRODUCTION:

The complete obturation of root canal system and achievement of a "fluid tight" seal is often cited as a major goal of root canal treatment. Hatton indicated "perhaps there is no technical operation in dentistry or surgery where so much depends on the conscientious adherence to high ideals as that of pulp canal filling[1]." For years, lateral compaction of cold gutta percha with a sealer has been the standard against which the other methods of canal obturation have been judged. However, some authors have reported that lateral condensation does not result in a homogenous mass of gutta percha and thus does not provide the fluid tight apical seal[2]. Johnson described a unique yet simple method of canal obturation with thermoplasticized alpha phase gutta percha carrier into the canal on an endodontic file.[3]What was a curiosity in 1978, has become a popular and respected technique of canal obturation today. "Thermafil" is a patented endodontic obturator consisting of flexible central carrier, sized and tapered to match variable taper files. The central carrier is uniformly coated with a layer of refined and tested alpha phase gutta percha.[3]Thermafil provides a better apical seal but have the problems of extension over the apical foramen and apical microleakage due to the shrinkage of alpha phase gutta percha on cooling. A silicon based sealer, Roekoseal Automix (Roeko dental products, Germany) has been shown to provide consistent seal over a period of 18 months.[4] The new root canal filling paste Guttaflow

(Coltene/ Whaledent, Switzerland) is a modification of this sealer.[5]

It combines the sealer with a very fine gutta percha powder making it the first sealer/gutta percha combination that is flowable at room temperature. The gutta percha powder is extremely fine with a particle size less than 30 microns and the nano silver provides the preservative effect. The manufacturers claim a better seal and good adaptability because of increased flowability and fact that this material expands slightly on setting making it an interesting material for obturation in near future.

Microleakage is defined as flow of oral fluid and bacteria into the microscopic gap between a prepared tooth surface and a restorative material.[6]When materials are used for obturation, a microscopic space always exists which leads to microleakage. Reinfection after root canal treatment is caused by improper obturation and microleakage allowing bacteria and there toxins to gain access into the canal system either coronally or apically. Fluid tight apical seal plays a crucial role in preventing reinfection. The quality of apical seal obtained by root canal obturation has been assessed by various methods like dye penetration, radioisotope penetration, bacterial leakage study, electro chemical means and fluid filtration technique.[3]The dye penetration method used for measuring the apical microleakage is the most popular and easily performed.[6] Various dyes used are India ink, basic fuschin, silver nitrate with developer and methylene blue. India ink has proved to be a useful aid in measuring microleakage in endodontic studies.

OBJECTIVES

This aim of this invitro study was to evaluate the apical sealing ability of GuttaFlow and Thermafil in comparison with regular gutta percha using Cold Lateral condensation.

Subjects and Methods:

This was a comparative study, which involved forty five extracted maxillary incisors consisting of three groups, each with 15 samples. Forty five human maxillary incisors extracted for periodontal reasons were collected. The teeth were observed under stereomicroscope and roots with open apices, cracks, and resorptive defects were excluded. The teeth were cleaned ultrasonically and sectioned at cementoenamel junction using a diamond disc and stored in distilled water before starting the root canal preparation. Pre-operative radiographs were taken and access cavities were prepared. The working length was determined with the help of radiographs. The canal lengths were reconfirmed by passing a 15 K file into each root canal until the tip of the file was visible at the tip of apical foramen. The working length was established 1 mm short of the apex. Canals were prepared with step back technique using 5.25% sodium hypochlorite and 17% EDTA as irrigants. The canals were enlarged upto ISO size 50 at the apical foramen. The samples were stored in distilled water until obturation. The teeth were divided into three groups of 15 specimens each.

Group I – Gutta Flow with master cone
Group II- Thermafil with AH Plus
Group III- Cold lateral condensation with AH Plus

The samples were dried using paper points and each canal was fitted with ISO size 50 gutta percha.

Group I (GuttaFlow with Master cone)

The polydimethyl siloxane based Gutta Flow sealer is the successor product of Roekoseal that contains fine gutta percha powder and nano silver in addition to the polydimethylsiloxane, zinc oxide, zirconium dioxide, paraffin based oil, hexachloroplatinic acid and silicic acid that are present in original Roekoseal. The GuttaFlow capsules were triturated for 30 seconds and the sealer was inserted into the root canal using the dispenser and "canal tip" provided by the manufacturer. The gutta percha master cone was also coated with the sealer according to the manufacturer's instructions, and slowly inserted into the canal. The "canal tip" was reinserted to dispense additional sealer to the spaces between the master cone and canal walls. The additional back fill of GuttaFlow was performed according to manufacturer's instructions. The last 2 mm of GuttaFlow was removed from the canal orifice with a heated instrument followed by placement of Type II Glass ionomer restoration.

Group II (Thermafil with AH Plus)

After drying the canals using paper points, Thermafil was heated in oven provided by the manufacturer. AH Plus sealer as recommended by the manufacturer was applied to the walls of the preparation using the master file. After adequate heating as indicated by the automatic oven, the carrier was delivered into the orifices of the canal to the working length. The handle was cut using a high speed inverted cone bur and the remainder reduced to 2 mm below the orifice and sealed with Type II Glass ionomer cement.

Group III (Cold Lateral Condensation with AH Plus)

After drying the canals, cold lateral condensation was performed by placing a master cone to the length using AH Plus sealer. The snug fit of master cone was checked and the canals were coated with the sealer, the master cone coated and placed in position. A spreader was inserted alongside the master cone wedging it against the canal wall and creating space for additional cones. Lateral and apical pressure was applied by revolving the spreader through half an arc. The spreader was removed while an additional gutta percha cone of corresponding size was inserted. The spreading procedure was inserted with apical pressure making space foradditional cones. This procedure was repeated several times until wedged cones block further access to the canal. The excess cones were removed upto 2 mm below the orifice and sealed with Glass ionomer cement type II.

After the preparation of all groups, roots were stored in gauze and placed in an incubator for 48 hours at 37 C and 100 % humidity to allow the sealer to set.

APICAL DYE LEAKAGE

Following obturation, the root surfaces of all the samples were coated with two coats of nail polish (Revlon Inc.) up until the apical 2 mm. The apical 2mm were free of any resin material. The teeth were then glued from incisal edges to the lid of a Petridish perpendicularly and immersed into the Petridish of India Ink, which engulfed the two thirds of the roots. The samples were left undisturbed for seven days. The teeth were then sectioned vertically along the long axis. To ensure that the sectioning process did not damage the inside of the canal, the sectioning was done with water cooled diamond disc along the root, short of reaching the gutta percha, thereby creating a stress canal. A chisel was used to wedge and split the teeth. The samples were then observed under Stereomicroscope. The dye leakage was measured with a millimeter scale from the apical constriction to the longest point of dye penetration along the canal walls and gutta percha itself (Fig. 1).

Statistical analysis was carried out using SPSS software. (Fig. 2).

RESULTS:

Multiple group comparison was done using ANOVA (Table 1) and there was no significant difference between the three groups with respect to the mean dye penetration (P>0.05) (Table 2).In this study there was no significant difference in the sealing abilities of the three study groups. The result in the present study showed that GuttaFlow provides a similar consistent seal as compared to either cold lateral compaction or Thermafil technique. Thermafil group showed 5 of 15 samples had sealer extrusion beyond the apex compared to 2 and 3 samples for lateral condensation and Guttaflow groups respectively.

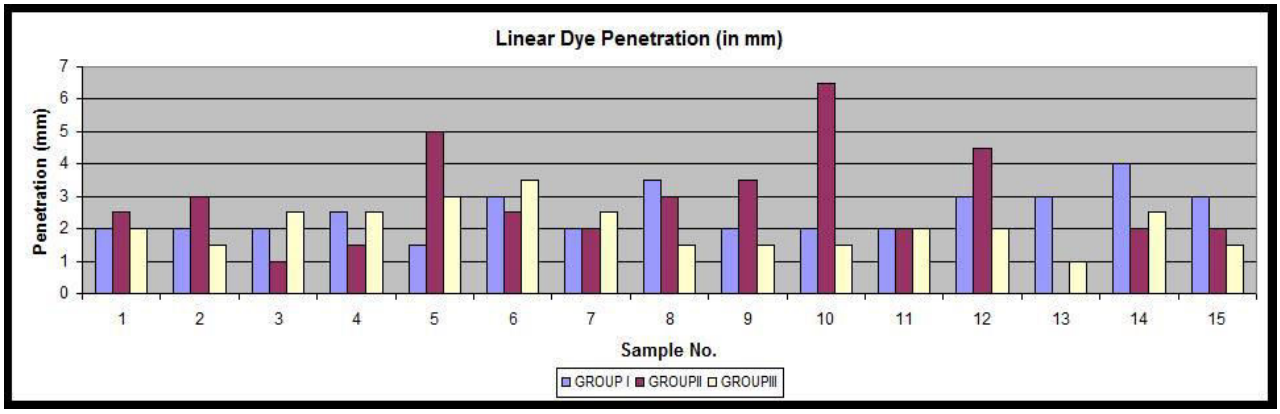

Figure 1 - The bar graph shows dye penetration of the individual samples of the three groups

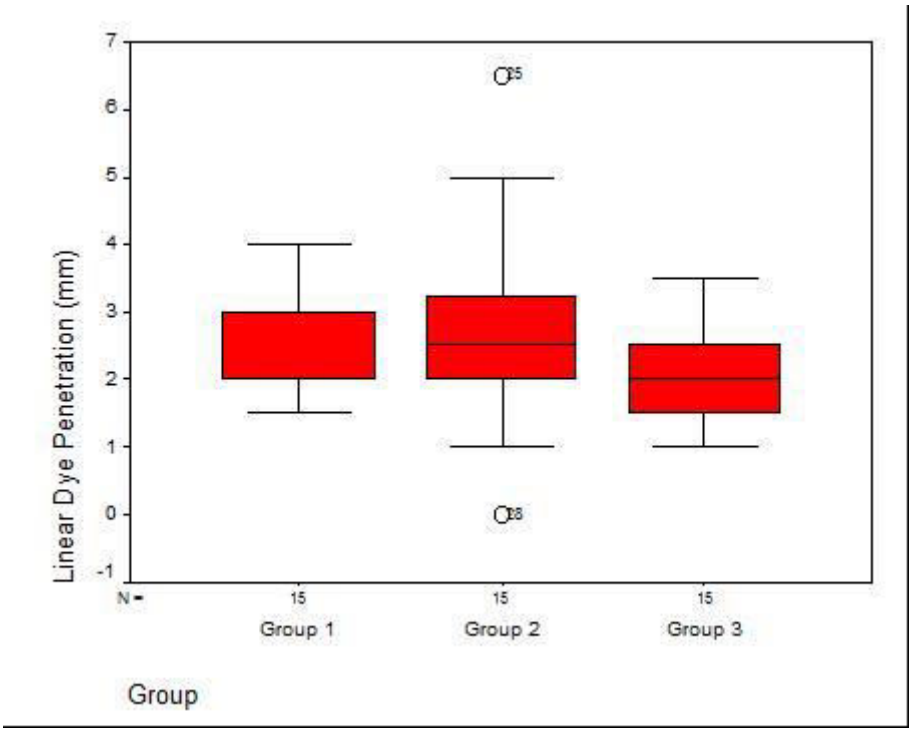

Figure 2- The bar graph showing the mean of dye leakage values of the three groups

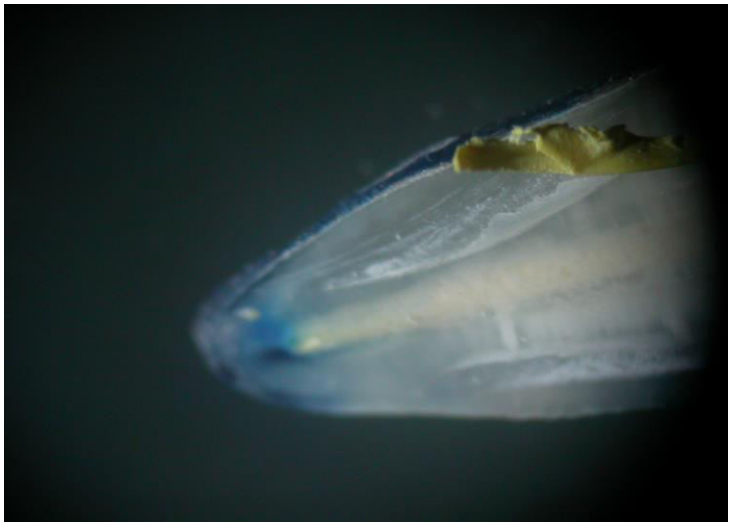

Figure 3 - Microleakage with cold lateral condensation

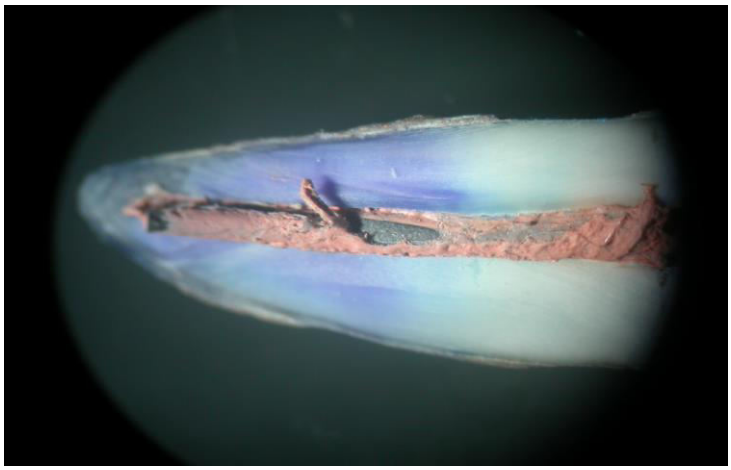

Figure 4 - Microleakage with Thermafil obturation technique

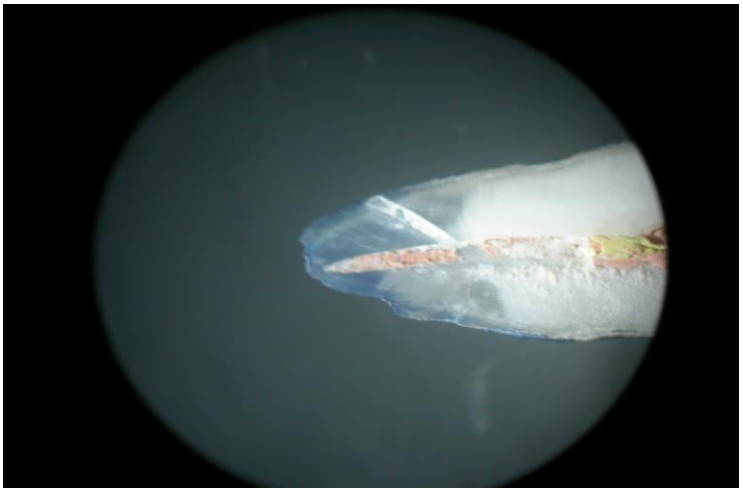

Figure 5 - Microleakage with GuttaFlow obturation technique

Table 1:

Descriptives

Linear Dye Penetration (mm)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Group 1	15	2.5000	.7071	.1826	2.1084	2.8916	1.50	4.00
Group 2	15	2.7333	1.6352	.4222	1.8278	3.6389	.00	6.50
Group 3	15	2.0667	.6779	.1750	1.6913	2.4421	1.00	3.50
Total	45	2.4333	1.1109	.1656	2.0996	2.7671	.00	6.50

Table 2:

ANOVA

Linear Dye Penetration (mm)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.433	2	1.717	1.417	.254
Within Groups	50.867	42	1.211		
Total	54.300	44			

DISCUSSION:

An effort was made in this study to balance the composition of experimental group in terms of canal anatomy. Absolute standardization is clearly impossible because of variability in canal anatomy, however relative standardization is possible, particularly of the prepared canals, in that of a standard apical size and taper can be produced[6]. In the present study step back preparation was followed and all the samples were enlarged to size fifty.

In the present study all three groups showed microleakage which was consistent with the finding of Punia SK et al[7] and Al-Kahtani AM found the same with respect to Thermafil technique[8].

Cold lateral condensation of gutta percha is currently the most accepted obturation technique. Clearly use of such technique will not result the movement of the core filling material out of the main canal. There are however number of other methods for filling the canal where movement of material is possible, they include warm lateral condensation, warm vertical compaction, coated carrier system, injected thermoplasticized technique, cold flowable technique. As reflected in various dye penetration studies, lateral condensation is also often used as a control for evaluating sealing ability of many new obturation techniques. Advantages of this technique include its predictability, relative ease of use, conservative preparation and controlled placement of materials. Disadvantages include a lack of homogeneity of gutta percha mass, an increased number of voids and sealer pools, and less adaptation to canal walls and irregularities[4]. In this study, cold lateral condensation showed the least mean microleakage value, this can be attributed to the use of AH Plus sealer (Fig.3) and was consistent with the study done by Punia SK et al. They found that the microleakage of Cold lateral condensation with AH Plus was low when compared to Thermafil with AH Plus but it was not significant.[7]

The Thermafil obturation technique was introduced by Ben Johnson in late 1970's and was reported in the Journal of Endodontics in June 1978. The technique began as a heated file warmed the gutta percha and helped adapt the entire body of the material. Since files became too flexible when heated, he started placing the gutta percha on the files outside the mouth and inserting them into prepared root canal spaces, hence the Thermafil concept was born[9]. Since then a lot of changes have occurred in Thermafil the most significant being replacement of metal carriers by plastic. In this study Thermafil was used with AH Plus sealer as recommended by the manufacturer after removal of smear layer (Fig.4). A literature review by Beck and Donnelly found no significant difference between the apical leakage of Thermafil and lateral condensation. This is consistent in the present study[10]. Bhandi SH et al in their study concluded that Thermafil with AH plus showed lesser microleakage when compared to Guttaflow.[11] Mozayeni et al found that Thermafil/Adseal showed higher mean apical microleakage than gutta percha/Adseal.[12]

The GuttaFlow is an enhanced formula of the original Roekoseal. It combines the sealer with a very fine gutta percha powder making it the first gutta percha/ sealer combination that is flowable at room temperature. Manufacturers claim that the sealer expands 0.2% on setting. This expansion combined with close adaptation of gutta percha cone against the instrumented canal wall

may enhance the flow and adaptation against the dentinal tubule wall [13](Fig.5).

It is noteworthy that the incorporation of gutta percha particles into the polydimethylsiloxane based sealer does not appear to create a leak free seal between gutta percha and sealer. Presumably in the absence of heat or solvent, there is no chemical union between the discrete gutta percha filler particles and gutta percha master cone[13]. In the present study, GuttaFlow provides a similar consistent seal as compared to either cold lateral compaction or Thermafil technique, though Brackett MG et al found the sealing ability was compromised.[14]

Guttaflow also belongs to the category of root canal filling paste, which has high risk of overfilling. This can be minimized by using a master cone guttapercha. Though it was not a part of the study, still this could lead to postoperative pain and in the present study might have limited the penetration of dye after sealer had set[15]. However further long term studies are required for evaluation of long term sealing ability of GuttaFlow.

CONCLUSION

Following conclusions were draws from this study.

1. All three groups showed microleakage and none of the methods was able to achieve perfect apical seal.
2. Mean microleakage value was maximum for Thermafil group, followed by Guttaflow with master cone and Cold lateral condensation with AH Plus sealer. Though there was a difference in the mean leakage values, it was not statistically significant.
3. The result in the present study showed that Gutta Flow provides a similar consistent seal as compared to either cold lateral compaction or Thermafil technique.

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