

A comparison of apical sealing ability between GuttaFlow and AH plus: An *in vitro* study

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Received: 23-04-16

Accepted: 11-07-16

Published: 25-07-16

Abstract

Aims: The present study aimed to compare apical sealing ability between GuttaFlow and AH Plus. **Materials and Method:** Eighty extracted human maxillary anterior teeth with fully formed apex and straight root were collected for this study. The root canals were cleaned and shaped using a standard step back preparation to size 60# master apical file at the established working length and divided into four groups: Group 1, GuttaFlow sealer with gutta-percha; Group 2, AH Plus sealer with gutta-percha; Group 3, positive control group (Teeth were instrumented and left without obturation); Group 4, negative control group (Teeth were totally coated with nail varnish) Dye leakage was carried out. Statistical analysis was done using the Statistical Package for the Social Sciences software and Student's unpaired *t*-test. **Results:** The GuttaFlow group had a mean leakage of 1.38 mm whereas AH Plus had a mean of 1.425 mm. The standard deviation of GuttaFlow and AH Plus were 0.3861 and 0.3226, respectively. Student's unpaired *t*-test disclosed no significant difference ($P < 0.05$) between the groups. **Conclusion:** None of the sealers used in the study could completely seal the apical foramen to have a fluid-tight seal. GuttaFlow and AH Plus showed no statistically significant difference in microleakage; the better result was shown by GuttaFlow.

Key words: AH Plus, apical leakage, GuttaFlow, sealer

INTRODUCTION

Obliteration of the root canal space with an inert filling material, formation of a hermetic seal, and elimination of any portal entry or exit to periapical tissues have been suggested as objectives for effective endodontic treatment.^[1]

A key to successful endodontics and a major aim of modern nonsurgical root canal treatment is to seal completely both the apical and coronal routes of potential leakage and maintain the disinfected status achieved by chemical or mechanical cleaning and to prevent reinfection and passage of bacterial byproducts, allowing the periodontium to maintain its integrity and to achieve healing.^[2]

Access this article online	
Quick Response Code:	Website: www.jispcd.org
	DOI: 10.4103/2231-0762.186794

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How to cite this article: Patil P, Rathore VP, Hotkar C, Savgave SS, Raghavendra K, Ingale P. A comparison of apical sealing ability between GuttaFlow and AH plus: An *in vitro* study. J Int Soc Prevent Communit Dent 2016;6:377-82.

The method most commonly recommended for obturation is the use of a large mass of solid and inert material (gutta-percha) associated with an endodontic sealer applied using the lateral-condensation obturation technique.^[3]

For complete sealing of the canal, the root canal sealer is required to have bonding capability with the dentin of the root canal. Advances in adhesives have endorsed attempts to reduce leakage by bonding to root canal walls. Total-etch adhesives have been used with resin cements as one of alternative root filling materials. The results demonstrated that dentin adhesives significantly reduced apical leakage. Self-etching primers have conjointly been tested for bonding to root canal dentin.^[4]

Various materials used as sealers have been tested from time to time to evaluate their sealing abilities to fulfill the objective of obtaining a hermetic apical seal.

The purpose of this study is to compare systematically the apical sealing ability provided by two endodontic sealers, namely, GuttaFlow and AH Plus using a dye penetration method.

MATERIALS AND METHODS

Eighty extracted human maxillary anterior teeth with fully formed apex and straight root were collected for this study. All the teeth were stored in 4% formalin until the sample was completed. Organic debris was removed by storing teeth in 5.25% sodium hypochlorite for 8 h. Subsequently, they were washed with tap water for 1 h and stored in saline until use.

The most common and most scientific method of sample size calculation is power analysis. This method is one of the methods used for calculating sample size for clinical studies and clinical trials. Simple calculation was carried out manually with the help of the same formula, sample size = $2 SD^2 (1.96 + 0.842)^2/d^2$.

Exclusion criteria

- Incompletely formed root apex
- Evident root fracture
- Bifurcating canals
- Calcified canals
- Pulp stones.

Inclusion criteria

- Caries-free teeth
- Type I root canal anatomy.

With the help of a diamond disk with water splash coolant, teeth were decoronated to obtain a standardized length of 15 mm, following pulp extirpation with barbed broach, a size 15 K file was inserted into canal until it was seen at the apical foramen to check for apical patency. Working length was determined to be 1 mm short of that position. Root canals were cleaned and shaped using standard step back preparation to size 60# master apical file at the established working length. 5.25% sodium hypochlorite and saline was used for irrigation between instrumentation and dried with paper points. The teeth were randomly divided into four groups of 20 each.

Groups

Teeth were divided into (20 samples containing each)

Group 1 – GuttaFlow sealer with gutta-percha

Group 2 – AH Plus sealer with gutta-percha

Group 3 – Positive control group (teeth were instrumented and left without obturation)

Group 4 – Negative control group (teeth were completely coated with nail varnish).

Canal filling

The prepared teeth were filled by using the lateral compaction technique. Endodontic sealers were mixed and used according to manufacturer's instructions, and introduced into the canal space using Lentulo spiral filler.

Group 1: GuttaFlow sealer with gutta-percha

Twenty teeth in group 1 were obturated with cold lateral condensation. A standardized ISO No. 60 Master Cone guttapercha was fitted up to the working length. GuttaFlow sealer was mixed according to the manufacturer's instructions and introduced into the canal. The apical part of master gutta-percha cone was coated with sealer and placed into the canal. The master cone was laterally condensed by finger spreader, inserted 1 mm short of working length space created by the spreader, and was filled with auxiliary gutta-percha point. The procedure was repeated until gutta-percha point could not be introduced more than 3 mm into the root canal. Excess gutta-percha was trimmed with a hot plastic instrument and was condensed with a pluggger.

Group 2: AH-Plus sealer with gutta-percha

AH Plus sealer was mixed according to the manufacturer's instructions and placed in the canal using a lentulospiral to the working length. The master

cone was selected to fit the canal snugly, was coated with AH Plus, and laterally condensed with finger spreaders. Coronal surplus of gutta-percha was removed by heat and the gutta-percha was compacted.

Group 3: Positive control group

Teeth were instrumented and left without obturation.

Group 4: Negative control group

Teeth were completely coated with nail varnish.

Following obturation of each group, gutta-percha was removed from the coronal 2 mm of the obturated root canals with a warm instrument after the sealer had hardened and the coronal end of all canals were sealed with glass ionomer cement.

The teeth were stored in an incubator in 100% humidity at 37°C for 48 h to ensure complete setting of the sealers. Root surfaces of all the samples except negative control were coated with two coats of nail varnish except apical 2 mm. Dye leakage procedure was carried out.

Linear dye leakage method

All the root surfaces of all the teeth were thoroughly dried and coated with two coats of nail varnish, except at the apical 2 mm of the root, with each coat being allowed to dry before the subsequent one was applied.

These samples were suspended in dye, i.e., 1% methylene blue in a glass container for 72 h at 37°C in the incubator. The sample were suspended in the dye in a vertical direction with the help of a sticky wax so that the dye can penetrate by capillary action.

After removal from the dye, the teeth were washed under running tap water to remove excess dye and nail varnish was removed using bard parker blade.

A demineralization and clearing process was carried out. The teeth were demineralized by placing in 5% nitric acid solution; the acid was changed daily for 5 days. The teeth were dehydrated in 70, 80, 90%, and absolute alcohol for 1 h in each concentration. By immersing the teeth in methyl salicylate solution, clearing process was completed.

The samples were then examined under stereomicroscope (magnification: 4–40×) for the evaluation of dye penetration. Single examiner

measured the extent of microleakage. The dye penetration scores were recorded and tabulated, and statistical analysis was carried out.

RESULTS

The study was performed to evaluate the apical sealing ability between GuttaFlow and AH Plus. The efficacy was evaluated based on the dye penetration test. This *in-vitro* study was conducted to evaluate the apical sealing ability between GuttaFlow and AH Plus.

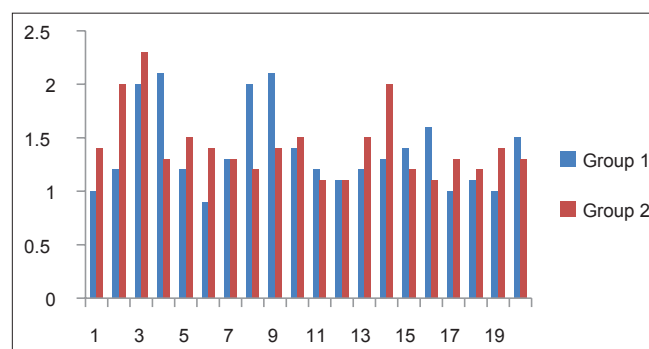
In this study, a total of 80 maxillary anterior teeth were used. They were divided into four groups. The first and second group consisted of 20 samples each, and the third and fourth group had 20 samples each. The first and second group served as GuttaFlow and AH Plus, respectively. The third and fourth group served as positive and negative controls, respectively.

The original values of apical microleakage for the two sealers were recorded. [Table 1; Graph 1] The group AH Plus showed more leakage values than the GuttaFlow group. Mean leakage values and standard deviation (SD) for apical leakage of GuttaFlow and AH Plus are shown in Table 2. The results showed that the GuttaFlow group had a mean leakage of 1.38 mm whereas AH Plus had a mean of 1.425 mm [Table 1 and Graph 2]. The SD of GuttaFlow and AH Plus were 0.3861 and 0.3226, respectively [Table 1 and Graph 3].

Table 1: Descriptive table of dye leakage

Summary	GuttaFlow	AH Plus
Sample size	20	20
Mean	1.38	1.425
SD	0.3861	0.3226
Minimum	0.9	1.1
Maximum	2.1	2.3
Median	1.250	1.350

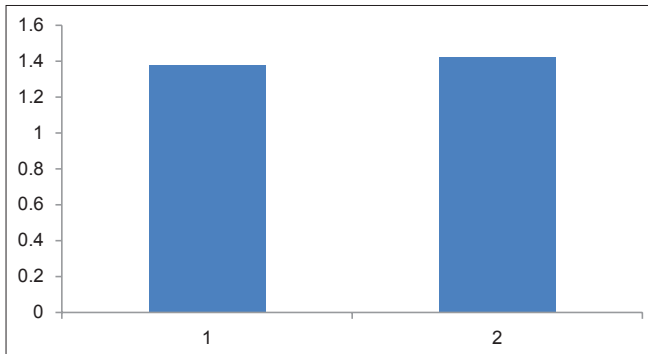
SD=Standard Deviation



Graph 1: Original values (in mm) of apical microleakage. (1. Guttaflow Group, 2. AH Plus group)

Table 2: Comparison of GuttaFlow and AH Plus with respect to microleakage values by Student's unpaired t-test

Type of sealers	Linear dye penetration		Mean difference	Observation	t	P	Significance
	Mean	Standard deviation					
GuttaFlow	1.38	0.3861	0.0450	20	0.4000	0.6914	Non-significant
AH Plus	1.425	0.3226		20			



Graph 2: Comparison of GuttaFlow and AH Plus with respect to mean microleakage. (1. Guttaflow Group, 2. AHPlus)

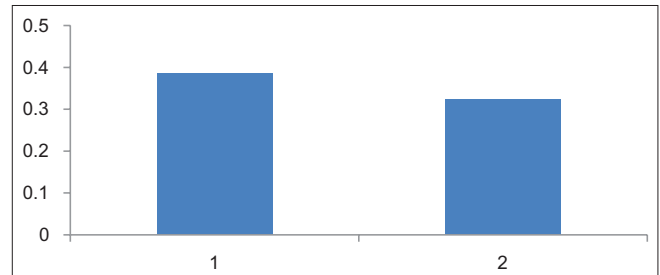
Statistical analysis done using the Statistical Package for Social Sciences software and Student's unpaired t-test disclosed no significant difference ($P > 0.05$) between the groups [Table 2].

DISCUSSION

The goal of root canal filling is to prevent the ingress of microorganisms and their byproducts along the root canal.^[5] Three-dimensional obturation of root canal including apical seal greatly depends on the sealing ability of the obturating material and the root canal sealer.^[6] The latter has a significant influence on microleakage of root canal obturation.^[7]

A new silicone-based sealer (GuttaFlow) has been introduced as one of various roots filling material. GuttaFlow is 2 in 1 cold, fluid obturation system that mixes sealer and gutta-percha together. It consists of a polymer matrix, which is filled with very finely ground gutta-percha. Polydimethylsiloxane has been utilized in the dental field for many years, especially in prosthodontics, as an impression material with only limited dimensional change in setting expansion. The finely ground gutta-percha powder and the silicone-based matrix are dispensed homogeneously after mixing. Laboratory investigations indicate setting expansion of 0.2%, biocompatibility.^[8,9]

GuttaFlow contains nanosilver. Nanosilver is metallic silver that is uniformly dispersed on the surface of the filling. The corrosion or color changes in GuttaFlow



Graph 3: Standard deviation of apical microleakage of both groups. (1. Guttaflow Group, 2. AH Plus Group)

are not caused by the chemical type and concentration of the nanosilver. There is adequate nanosilver in the material to avert further spread of bacteria, and nanosilver is highly biocompatible.^[10]

AH Plus (Dentsply Maillefer, Ballaigues, Switzerland) is an epoxy-based endodontic sealer that is used with gutta-percha. It consists of a paste-to-paste system, supplied in two tubes in a double barrel syringe. AH Plus contains silicone oils along with other ingredients. AH Plus has a film thickness of approximately 25 mm, which is clearly below the value of less than 50 mm required by the ISO standard for root canal sealing materials.^[11]

In this dye leakage study, methylene blue dye was used because it shows a high sensitivity and its particles are of a similar dimension to microorganisms and their metabolites.^[12,13]

In the present study, dye penetration was observed in all specimens except the negative control teeth. Statistical analysis revealed that the lowest dye penetration was in Group 1 (GuttaFlow) followed by (in ascending order of dye penetration) Group 2 (AH Plus), and the positive control. Group 2 showed a mean linear dye penetration of 1.425 mm, whereas Group 1 showed a mean linear dye penetration of 1.38 mm. The difference between the mean linear dye penetration between Groups I and II was not statistically significant.

The null hypothesis of the present study was partially accepted because the results showed that the sealing ability of AH plus was similar to that of the GuttaFlow

within acceptable limits. The most likely explanation for low mean leakage scores in Group I would be the setting expansion of GuttaFlow by 0.2%, as claimed by manufacturers, and validated in studies.^[14,15]

The presence of fine sized gutta-percha particles (nanoparticles less than 30 μ) further bestows increased flowability to GuttaFlow, resulting in better coating capacity and adaptation to root canal walls, as well as into dentinal tubules.^[16,17]

Leakage of AH Plus may be rippled from inadequate bonding between the sealer and the gutta-percha point, allowing fluid to pass at the interface. This possibility is in agreement with the results of Tay *et al.*^[18]

One *in vitro* study compared the microleakage of three sealers, namely, endosequence bioceramic (BC) sealer, AH Plus, and Epiphany, suggesting that newly introduced BC and Epiphany sealers sealed better compared to AH Plus Sealer.^[19]

In one comparative study of apical sealing ability of a new resin-based obturation system (Resilion) with AH 26, it was found that there was no significant difference between both the materials.^[20]

Study limitations

This is an *in vitro* study; further *in-vivo* studies should be conducted to correlate with the present study.

Future research directions

The sealers serve as filler for the canal irregularities as well as minor defects between the canal wall and the filling material. They seal the lateral and the accessory canals and assist in microbial control. Further studies should aim for a better sealing ability on basis of this research platform. This study will be helpful for researchers to work in a most important direction i.e., apical seal on which the success of root canal treatment depends.

CONCLUSION

With the results obtained after evaluation and comparison of the sealing ability of GuttaFlow with AH Plus sealers, it could be concluded that

- Two experimental groups showed comparable apical leakage
- Dye penetration was observed in all the specimens, except the negative control. This shows that none of the sealers used in the study could completely seal the apical foramen to have a fluid-tight seal

- Though GuttaFlow and AH Plus showed no statistically significant difference in microleakage, the better result was shown by GuttaFlow
- GuttaFlow seems to be a promising filling material because of the good sealing ability, ease of handling, and application of the material. The results of dye penetration studies only indicate the comparative sealing ability of root canal fillings *in vitro* and they do not indicate their ability to prevent the ingress of bacteria into filled root canals *in vivo*
- Further *in vivo* studies need to be done to correlate with the present study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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