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A comparison of apical seal of Bio Root-RCS, GuttaFlow-2 and AH-26 as root canal sealers in laterally condensed gutta-percha obturation - An In-vitro study

[1]Romal Preet Singh, Senior Lecturer, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh.

[2]Sunil Malhan, Professor & HOD, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh.

[3]Arvind Arora, Professor, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh.

[4]Gursandeep Sandhu, Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh.

[5]Himanshu Sood, Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh.

Corresponding Author: Himanshu Sood, Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh.

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Abstract

Aims: The aim of this study is to determine sealing ability of three different root canal sealers: Bio Root-RCS, GuttaFlow-2, AH-26 using dye penetration under Stereomicroscope.

Material and Methods: The study was conducted on 51 human mandibular premolar. The crowns of the teeth shall be sectioned at the cement-enamel junction using a diamond disc. Samples divided into three groups with different sealers i.e Bio Root-RCS, GuttaFlow-2 & AH-26. Pulp tissue is removed, canals are dried and obturated with 60 no. master cone and obturated using different sealers of respective group using lateral condensation technique. Methylene Blue dye is used for dye penetration. Dye penetration was examined under stereomicroscope and the data was statistically analyzed with One Way Analysis of variance (ANOVA) and Kruskel Walley's test.

Results: Positive controls leaked at least more than 6 mm into the gutta-percha, and no leakage was observed in the negative control group. AH-26 has shown the maximum score of 2.4 mean penetration, while Bio

Root-RCS has shown the least, of 0.93 mean penetration, One Way ANOVA test showed statistically significant difference between AH-26 and Bio Root-RCS. Kruskal Walley test observed statistically significant difference in leakage (p>.001) between AH-26 and Bio Root-RCS, Guttaflow-2 and statically no significant difference found between Bio Root-RCS and Gutta flow-2.

Keywords: AH-26, apical seal, Bio Root-RCS, GuttaFlow-2, sterio-microscope.

Introduction

Microleakage of endodontically treated teeth is a major cause of treatment failure. A good apical seal plays critical role in the success of endodontic treatment. Accurate seal of the root canal is a difficult and sensitive task due to attributed root anatomy variations and accessory canals.[1]

According to Ingle and Beveridge, the majority of endodontic failures are caused mainly by incomplete sealing of the root canal.[2]

Main objective of obturation in endodontics is total obliteration of root canal system and development of a fluid tight seal at the apical foramen, which provides a biological environment for healing of periapical tissue.[3]

Inadequate sealing with an endodontic sealer can have detrimental effects such as prolongation of inflammation and infection.[4]

The better the apical seal better was the results. Sealers seal off voids, patent accessory canals and multiple foramina, form a bond between GP and root canal dentin, and entomb the remaining bacteria. [5]

Sealers can be a cause of root canal failure due to microleakage at sealer-dentin or sealer-core material interface. Bonding of the sealer to the root canal dentin wall and formation of a monoblock can eliminate this drawback.

According to Grossman 12th edition ideal root canal sealer should have following properties: -

1. Provide an excellent seal when set
2. Produce adequate adhesion among it, the canal walls and the filling material
3. Be radio opaque.
4. Be non-staining.
5. Be dimensionally stable
6. Be easily mixed and introduced into the canals
7. Be easily removed, if necessary.
8. Be insoluble in tissue fluids.
9. Be bactericidal or discourage bacterial growth.
10. Be non-irritating to periradicular tissues.
11. Be slow setting to ensure sufficient working.[6]

An ideal endodontic sealer should fulfill all ideal requisites. But there is no sealer till now which can fulfill all the desired properties. The tight seal at the apex can be enhanced when the sealer bonds chemically to the dentinal wall of root canal, and mild expansion of the sealer improves its adaptation to the canal walls. It should be antibacterial and resistant to dissolution.

The present study was undertaken to compare and evaluate the apical sealing ability of Bio Root-RCS, Gutta Flow 2 and AH-26 sealer. The apical seal is evaluated using Dye penetration method under Steriomicroscope at 40X magnification.

Material and methodology

Fifty-one freshly extracted human single-rooted mandibular premolar teeth with completely formed apex were selected.

Tooth preparation for study

The teeth were cleaned of debris, soft tissue remenants. The crowns of the teeth were sectioned at the cement-enamel junction using a diamond disc. The gross pulp tissue was removed with coarse barbed broaches.

A No. 15-file was then be inserted into the root canal of each specimen until it was seen just exiting at the apical foramen. The working length was determined by deducting 1.0 mm from this length. Root canal preparation was done using hand instruments (K-files, 15–60) by step-back technique.

A volume of 3 ml of 5% NaOCl and normal saline were alternatively used along with EDTA to remove the smear layer for each specimen. The canals were dried with paper points, and patency of the apical foramen was confirmed by passing a No. 15 K-file 1.0 mm through it before obturation was carried out. No. 60 master GP cone is placed in the canal, and its fit and length was confirmed. The tip of the master cone was coated with sealer and seated. Obturation was completed using a standard lateral condensation technique.

Excess GP was removed from the coronal portion of the root canal with a warm instrument, and the material was vertically compacted. The access was then sealed with intermediate restorative material.

Teeth were randomly divided into three groups:

- Group 1: 15 teeth obturated with Bio Root-RCS as sealer.
- Group 2: 15 teeth obturated with Gutta Flow 2 as sealer.
- Group 3: 15 teeth obturated with AH-26 as sealer.
- Positive control: 3 teeth (obturated with no sealer).
- Negative control: 3 teeth (left empty and sealed with IRM).

Scoring for dye penetration for microleakage in root canal wall:

• Score 0: Dye not visible on the root canal walls

• Score 1: Dye visible on the root canal walls

• Score 2: Dye infiltrations up to half of the distance longitudinally

• Score 3: Dye infiltrations more than half of the root surface longitudinally.

Teeth preparation for Stereo-microscopic analysis

All specimens were then covered with two-layer fingernail varnish so that only 1 mm of the apical foramen remained exposed. The negative controls were completely covered with fingernail varnish including the apical foramen. All specimens were immersed in 1% methylene blue dye for 72 hr. After removal from the dye, the roots were rinsed in tap water, and the fingernail varnish was completely removed by scraping with a Bard–Parker number 11 blades.

The roots were grooved longitudinally on the buccal and lingual surface using cylindrical diamond point in a high-speed handpiece under constant air–water spray and then they were split into two halves with chisel and mallet.

Then the halves were used for leakage evaluation. The amount of microleakage on the fractured side of the split root was scored from apex to the maximum extent of dye penetration in coronal direction. Scoring was done by viewing the greatest extent of the dye with a stereo-microscope at 40X magnification on an arbitrary scale.

Statistical methods

Statistical methods used for analysis are:

1. Kruskal-Walli's test.
2. Analysis of variance (ANOVA) test.

Results

Results of the present study showed that Bio Root-RCS has shown better sealing ability than GuttaFlow-2 and AH-26.

Bio Root-RCS has shown the best apical seal among three sealers. The mean value seen for Bio Root-RCS was 0.93, for GuttaFlow-2 it was 1.47 and for AH-26 2.4.

Positive controls leaked at least more than 6 mm into the gutta-percha, and no leakage was observed in the negative control group. AH-26 has shown the maximum score of 2.4 mean penetration, while Bio Root-RCS has shown the least, of 0.93 mean penetration. One Way ANOVA test showed statistically significant difference between AH26 and Bio Root-RCS. Kruskal Walley test observed statistically significant difference in leakage ($p>.001$) between AH-26 and Bio Root-RCS, Guttaflow-2 and statically no significant difference found between Bio Root-RCS and Gutta flow-2.

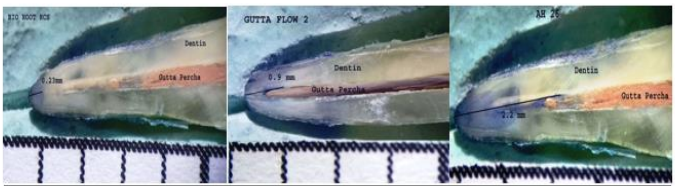


Table 1:

Summary statistics:							
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ah 26	15	0	15	1.000	3.000	2.400	0.632
Gutta flow-2	15	0	15	0.000	3.000	1.467	0.915
Bio Root-RCS	15	0	15	0.000	2.000	0.933	0.704

Table 2:

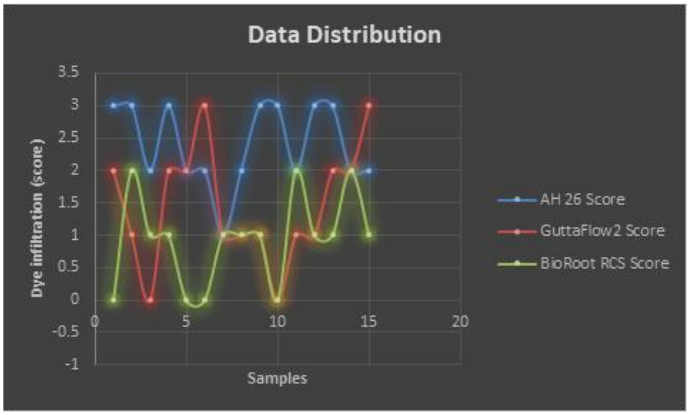
Analysis of variance (SCORE):					
Source	DF	Sum of squares	Mean squares	F	Pr > F
Model	2	16.533	8.267	14.308	**<0.0001**
Error	42	24.267	0.578		
Corrected Total	44	40.800			
Computed against model Y=Mean(Y)					

Table 3:

Kruskal-Wallis test / Two-tailed test:				
K (Observed value)	18.325			
K (Critical value)	5.991			
DF	2			
p-value (one-tailed)	0.000			
alpha	0.05			
An approximation has been used to compute the p-value.				
Multiple pairwise comparisons using Dunn's procedure / Two-tailed test:				
Sample	Frequency	Sum of ranks	Mean of ranks	Groups
AH26	15	504.000	33.600	A
Guttaflow2	15	318.000	21.200	B

Bio Root-RCS	15	213.000	14.200	B

Graph 1: Score Distribution of Ah-26, GuttaFlow2 and Bio Root-RCS



Discussion

The main objective of the root canal therapy is to obturate the root canal system and create an impervious apico-coronal seal [7].

Various endodontic materials have been advocated for obturation. Gutta-percha is by far the most universally used solid core obturation material. Although not the ideal filling material, it satisfies majority of Grossman's criteria. Gutta-percha, however, has few disadvantages like lack of rigidity and adhesiveness, ease of displacement under pressure, which are often overshadowed by its advantages. Lateral condensation of gutta-percha has remained the most widely used method of obturating root canals and is also often used as a control for evaluating sealing ability of new obturation techniques

The sealing prevents the transmission of microorganism, toxin and their endotoxin between the root canal system and periapical area [8].

This present study aimed at evaluating the sealing ability of contemporary sealer bio-Root-RCS with Guttaflow-2 and AH-26.

Comparing the degree of apical microleakage resistance by various techniques, which one of them is the best still controversial. Each method views one aspect of the subject. As far as this study is concerned, we chose the dye penetration method by Methylene blue to evaluate the apical leakage. This stain is a standard material because it is simple, economical, and the same size as organic products such as butyric Acid [9]. Although it doesn't allow monitoring of the results of different experiment periods and observing the progress in microleakage [10].

According to the results of the present study, mean value for dye penetration in Bio Root-RCS is 0.93, which is lowest amongst all groups hence Bio Root-RCS possess superior seal among the three sealers.

Bio Root-RCS is based on tricalcium silicate and is water based; thus, it should be used with a single-cone obturation technique rather than warm vertical compaction because the sealer properties are changed when heated [11].

In the present study, Bio Root-RCS has shown greater sealing ability as compared to AH-26. In the study conducted by Via Pana et al, he compared the sealing ability of Bio Root-RCS and AH Plus and proposed that Bio Root-RCS showed a better sealing ability [12].

It is proposed that the amount of calcium that leaches from Bio Root-RCS is double the calcium that leaches from a similar kind of bio-ceramic sealer, Endo-sequence BC sealer [7].

In the present study Guttaflow-2 showed lower leakage compared to AH-26. The mean value of guttaflow-2 is1.47 whereas of AH-26 is 2.40. In this study also sealer was applied using master cone. The improvement in the sealing ability of Guttaflow-2 at the subsequent days

could be possibly because of the 0.2% setting expansion of the sealer [13].

Gutta Flow 2 (Roeko-Coltene, Germany) is a silicone-based root canal sealer. Base consist of Zirconium oxide, Poly methyl vinyl siloxane,

Poly methyl hydrogen siloxane, Gutta-percha; catalyst contains- Zirconium oxide, Poly methyl vinyl siloxane, Platinum catalyst. The particle size of its powder form is less than 30 μm, and it contains gutta-percha powder, polydimethyl siloxane, platinum catalyst, zirconium dioxide and micro-silver. Previous studies have shown that the biocompatibility of Gutta Flow 2 is higher than that of AH-Plus [13, 14].

The manufacturing company suggested using Gutta flow-2 as root canal filling alone or in conjunction with master gutta-percha. Many studies give unsatisfied outcome when GuttaFlow-2 is used alone. When used with gutta-percha it gives varying results, several studies have shown that it has the top sealing performance, others indicated GuttaFlow-2 as the worse [15].

According to Ajith Hindlekar et al, Gutta-Flow 2 when used in combination with Gutta-percha cone has the good apical sealing ability and shows promise as an obturation technique. Gutta-Flow 2 in combination with Gutta-percha cone shows a good apical sealing ability comparable to thermo-plasticized obturation technique and better than Lateral Condensation technique [16].

AH-26 is an epoxy resin-based sealer that sets by poly-addition reaction of the diamines present in its composition. In this study it is shown that the sealer possessed a gradual increase in the leakage values over time.

According to Attur KM et al, result of their study shows that AH26 showed better sealing ability as compared to ZOE. AH-26 and ZOE had lower microleakage. This was in accordance with various other studies. A statistically significant difference was found (P<0.05) when the apical seal produced by MTA was compared with AH-26 [17].

It is also noted that AH-26 had the best working characteristics with improved sealing ability, superior flow, good radiopacity, limited solubility, good adhesion, and adequate biocompatibility [18, 19].

According to Tay et al, AH-26 though it had superior sealing ability at the end of day 1, it is thought that they react with any exposed amino groups in the collagen to form covalent bonds between resin and collagen when the epoxide ring opens. This could have led to further gap at the interface and inadequate bonding between sealer and gutta-percha, allowing fluid to pass [20].

Within the limitations, the present in-vitro study suggests that Bio Root-RCS is showing best sealing ability than Gutta flow 2 and AH-26.

Although Bio Root-RCS has proven successful in numerous other clinical applications, further investigations should be conducted to determine whether Bio Root-RCS itself or the technique for its placement could be modified to increase its efficiency as a root canal sealer.

Conclusion

The results of the present in-vitro study showed that microleakage of Bio Root-RCS was significantly less compared to GuttaFlow-2 and AH-26. Dentinal tubular penetration was more in Bio Root-RCS group than GuttaFlow-2 and AH-26 groups. On an average, Bio Root-RCS showed deep sealer penetration, hence less dye leakage. Further studies are required to evaluate the efficacy of Bio Root-RCS as root canal sealer. Deeper the penetration, lesser is the leakage.

Although Bio Root-RCS has proven successful in numerous other clinical applications, further investigations should be conducted to determine whether

Bio Root-RCS itself or the technique for its placement could be modified to increase its efficiency as a root canal sealer.

Within the limitations of this study, it could be concluded that,

- None of the sealers provided complete sealing at all time periods.
- bio root-RCS showed superior sealing ability followed by Guttaflow-2 and AH-26.

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