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# Effect of Different Sealers on the Sealing Ability of Single Cone Obturating System-A Vitro Study

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## Abstract

**Aim:** The aim of the study was to compare the sealing ability of single cone obturation system using different sealers.

**Methods and Methodology:** Thirty extracted single canal teeth were selected and they were decoronated and standardized to a working length of 14 mm. The root canals were prepared using Neo endo Flex rotary file system until the size F3 and then divided into 3 groups (n=10each). Samples of groups were filled with single cone gutta-percha using AH plus, MTA Fillapex, and BioRoot RCS respectively. The linear apical dye leakage was measured using methylene blue dye under stereomicroscope and data was statistically analysed.

**Results:** Data were Statistically analysed using Kruskal-wallis test and Man whitney test. Gutta percha with MTA Fillapex shows highest mean microleakage values and Gutta Percha with BioRoot RCS shows lowest mean microleakage values.

**Conclusion:** All three groups showed significantly different dye leakage. The lowest apical dye leakage values were observed with single cone GP with BioRoot RCS and there is no significant difference between AH plus and MTA Fillapex.

**Keywords:** *AH PLUS, MTA Fillapex, BioRoot RCS, microleakage, single cone obturating system.*

**Introduction**

The main aim of a successful root canal treatment is to clean and shape the root canal system for receiving the root canal obturation materials[1]. Root canal treatment is ascribed to various essential factors such as instrumentation, biomechanical preparation, debridement, obturation, and post endodontic restoration, to prevent the bacteria from the oral and peri apical tissue and vice versa. The main aim of sealing root canal is to prevent periapical exudates from diffusing into the unfilled part of the canal, to avoid re-entry and colonization of bacteria[2]. Therefore, to accomplish a fluid tight seal, a root canal sealer is needed by reducing apical and coronal microleakage[3]. Sealer along with solid obturating material acts as to create hermetic, fluid tight seal[4,5].

Gutta-percha (GP), in combination with sealer, is the most commonly used material for endodontic root canal obturation. A root canal sealer is not only essential in filling the irregular spaces but also enhance the sealing during compaction enabling to penetrate small and normally in accessible areas, i.e.., in the dentinal tubules[5].

The commercially available sealers are categorized according to chemical components: zinc oxide eugenol, calcium hydroxide containing, resin based, glass-ionomer based, and bioceramic based sealers. AH Plus was developed by Dentsply (1997), composed of epoxy resin and amines. AH Plus (Dentsply Maillefer, Ballaigues, Switzerland) is the most regularly used epoxy resin-based sealer, because of its good physical and chemical properties and sealing ability[6]. This sealer exhibits toxicity after mixing and cautiously decrease after setting[7]. To overcome toxicity calcium silicate sealers were developed. MTA Fillapex is a new MTA-based sealer developed by Angelus (Londrina/parana/Brazil). The manufacturer claims that this type of sealer can provide perfect sealing ability and promotes cementum regeneration[8]. BioRoot RCS (Septodont, Saint-Maur-des Fosses, France) is a powder/liquid hydraulic tricalcium silicate-based cement (Gilles & Oliver 2012) marketed since February 2015 and commonly advised for single cone technique or cold lateral condensation root filling. BioRoot RCS showed supreme biocompatibility in both the fresh and set states[9]. Most of the endodontic failures are caused by the microleakage resulting from incomplete obturation[10]. Tasdemir et al.[11] concluded that the single-cone obturation technique may gives a better sealing then lateral condensation. In single cone obturation technique the single cone guuta-percha points used with the same diameter and taper of the last instrument used during the preparation of the canal. There is a possibility of a faster endodontic obturation with single cone obturation technique[12]. Microleakage test are important in appraise the quality of endodontic treatment. Passive dye penetration is one of method which is most widely used because of its sensitivity, ease of use and convenience[13]. The purpose of this study was to evaluate the apical microleakage of three matched taper single-cone obturation system: Gutta-percha/ AH Plus, Gutta-percha/MTA Fillapex, and Guttapercha/BioRoot RCS.

**Materials And Methodology**

Thirty single rooted human teeth were collected and scaling was done with ultrasonic scaler and autoclaved. They were Stored in saline until use. The crowns were sectioned and the length of roots was standardized at 14 mm. After determination of working lengths, root canals



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were instrumented with Neo Endo Flex rotary system (Neo Endo, India), until reaching to a master apical file of size F3, between files root canals were irrigated with 5ml of 3% Sodium hypochlorite, 17% EDTA and finally irrigated with saline.

**Root canal obturation:** Before starting obturation, a size #15 finger spreader (Mani Inc.,Tocigi- Ken, JA) was inserted externally from the apical direction into the apical foramen (0.5mm) of each sample in the group, in order to keep the apical foramen open, allow the dye to pass through the apical foramen. All external surfaces of roots were coated with three layers of nail varnish on the surface of the root except coronal surface of the root and apical foramen. After drying each coat, apply another layer of nail varnish. The finger spreader was gently removed, after the complete set of the varnish.

After applying the nail varnish, samples were divided into three experimental groups according to the sealer.

Group A: Single cone gutta-percha with AH Plus

Group B: Single cone gutta-percha with MTA Fillapex

Group C: Single cone gutta-percha with BioRoot RCS

The root canal sealer was applied to each canal using a #30 Lentulo spiral (Dentsply, Maillefer, Switzerland) rotated at 300 rpm away from the apex. The tip of the prefitted master cone was coated with a thin layer of sealer and inserted into the canal to its full working length using up and down slow pumping motion. Roots were filled using single-cone obturation technique with Dentsply gutta-percha size F3/AH Plus (Group A), Dentsply gutta-percha size F3/MTA Fillapex (Group B) and Dentsply gutta-percha size F3/BioRoot RCS (Group C).

Using a heated endodontic plugger sealed off the coronal excess of gutta-percha and the excess sealer was removed with the gauze wetted with distilled water. The quality of obturation was assessed radiographically. After finishing obturation, the coronal surface of each root was sealed with glass ionomer cement and coated with three layers of nail varnish. All samples were incubated for 1 week at $37^{O}$C and 95% humidity to allow the complete setting of sealers.

**Microleakage Assessment:** All samples were placed in 2% methylene blue dye and stored for 72 hours. Samples were thoroughly rinsed under running tap water and the nail varnish was removed with a scalpel blade no.15. The apical 7mm of each root was longitudinally sectioned in a buccolingual direction, and then a horizontal cut was made on the mesial or distal surface using a flexible diamond disc under water coolant. The apical 7 mm of the proximal portion of each sample was cut to expose the filling material that was then removed using endodontic explorer to allow a better evaluation of dye penetration.

Microleakage in each sample was evaluated under a digital stereomicroscope (Leice EZ4W, Germany) at 20X magnification. Pictures were captured, saved, and the maximum apical dye penetration leakage was measured using Image J software (National Institutes of Health, Bethesda, MD,USA).

**Statistical analysis**

The results were statistically analysed by Kruskal-wallis test and Man Whitney test using IBM SPSS version 20. All the levels of statistical significance was set at $P< 0.05$

**Results**

The mean values and standard deviations of apical dye penetration for all experimental groups are presented in table 1. As Figure 3 shows lowest mean dye penetration value of 0.9070 was observed in BioRoot RCS (Group C). MTA Fillapex (Group B) shows highest and significant($P < 0.05$) mean leakage values of 2.36 as shown in image 2. There is a statistically significant difference between group A&B and B&C. But when compared to group A&C, it shows statistically less significant difference is observed.



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Figure 1: specimen shows dye penetration of AH plus

Figure 2: specimen shows dye penetration of MTA Fillapex

Figure 3: specimen shows dye penetration of BioRoot RCS

**Apical microleakage means values:**

| Groups | N | Mean | Std. Deviation | Std. Error |
|---|---|---|---|---|
| Ah Plus | 10 | 1.2100 | .51088 | .16155 |
| Mta Fillapex | 10 | 2.3600 | .60222 | .19044 |
| Bioroot Rcs | 10 | .9070 | .36258 | .11466 |
| Total | 30 | 1.4923 | .79974 | .14601 |

Table 1: Means and standard deviation of groups.

Man Witney Test Group 1-2

| | GROUP | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Apical_Leakage | AH PLUS | 10 | 12.10 | 121.00 |
| | MTA FILLAPEX | 10 | 14.75 | 147.50 |
| | Total | 20 | | |

Table 2: Mean ranking between group 1& 2

Man Witney Test Group 1 & 3

| | Group | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Apical_Leakage | Ah Plus | 10 | 12.10 | 121.00 |
| | Bioroot RCS | 10 | 8.90 | 89.00 |
| | Total | 20 | | |

Table 3: Mean ranking between group 1&3

Man-Witney Test Group 2-3

| | GROUP | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Apical_Leakage | MTA FILLAPEX | 10 | 14.75 | 147.50 |
| | BIO ROOT RCS | 10 | 5.70 | 57.00 |
| | Total | 20 | | |

Table 4: Mean ranking between Group 2&3



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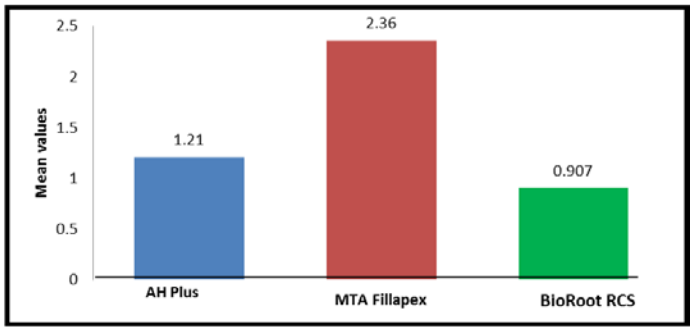


Figure 4: Mean microleakage values in the groups.

**Discussion**

Apical and coronal leakage has proven to be the one of the main reason for root canal treatment failure[10]. Therefore, the root canal filling should completely seal the canal space both coronally and apically to prevent microorganisms and tissue fluids from entering the canal space and vice versa. Moreover, the rotary instrumentation was found to be less time consuming, more comfortable, and more efficient than hand instrumentation and deliver a standardized root canal preparation[14].

During instrumentation, the root canals were irrigated with 3% NaOCl followed by a 17% EDTA solution. These irrigants remove the remaining organic tissues and smear layer, which may enhance sealer penetration inside the dentinal tubules and improve its sealing ability[15].

Regardless of the obturation technique, the main moto of root canal sealers is to achieve immediate and long lasting seal along the root canal wall. The development of new types of endodontic sealer and/or obturation core materials may overcome the microleakage accompanied by currently used material and encourage the use of single-cone obturation technique, especially with canals instrumented with greater taper Ni—Ti rotary files[16]. The study aimed to evaluate and compare the apical sealing ability of single-cone gutta-percha combined with AH Plus, MTA Fillapex, and BioRoot RCS root canal sealers. BioRoot RCS shows less apical dye penetration than AH Plus and MTA Fillapex.

In this study, the methylene blue dye penetration method was selected to evaluate apical microleakage because it is inexpensive and easy to manipulate. Also, it has a high degree of staining capability and a molecular weight lower than that of bacterial toxins. So it has a high penetration ability[17].

The highest leakage mean values were observed in MTA Fillapex. Sonmez Zet al.[18] found that MTA Fillapex sealer shows inferior sealing ability when compared with a resin-based sealer because of the presence of salicylate resin component. MTA Fillapex does not form calcium hydroxide on hydration[19,20] BioRoot RCS releases calcium hydroxide after setting, which was absent in MTA Fillapex and also exhibits low calcium ion release in solution[18]. Zhang et al.[21] found that the sealing ability of the AH Plus sealer was same as that of the sealing ability of bio ceramic sealer, when used with single-cone or continuous wave gutta-percha obturation techniques.

In this study mean values of AH Plus sealer are lower than that of MTA Fillapex. This can be better explained by a good adhesiveness and apical sealing ability of AH plus is due to its ability to penetrate into micro irregularities on the dentinal wall, its setting expansion after being inserted in the root canal, and its ability to form a covalent bond with amino groups of exposed radicular dentin collagen[15].

BioRoot RCS has gained in popularity, owing to fewer toxic effects on human periodontal ligament cells and induces osteogenic growth factor secretion[22]; and it also shows good biocompatibility when it contact with the mouse pulpal stem cells. BioRoot RCS sealer did not alter the cell viability and cell morphology[23]. BioRoot RCS extract spread better than those in the AH Plus extracts[24], and its particles plays a important role to create mineral plugs through interaction with dentinal fluids[25,26]. In tri calcium based sealers, biomineralization ability is important factor for entombing intra tubular bacteria and



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minimizing the leakage[27,28]. BioRoot RCS showed higher calcium ion release than other sealers over a prolonged duration[26]. The prolonged mineralizing ion release triggers the nucleation of calcium phosphate, which may improve the sealing ability of obturation materials[20,26]. Several studies reported that the development of a mineral infiltration zone in the material in contact with the tissues indicates the formation of tag like microstructures[23]. Pure inorganic form of resin free, eugenol free form of BioRoot RCS has a high pH for the formation of hydroxyapatite crystal formation, thus resulting in less microleakage.

**Conclusion**

With in the limitations of the study Single cone obturation with BioRoot RCS sealer shows better sealing ability compared to MTA Fillapex and AH plus sealer. Further in vivo studies are more helpful for conclusion.

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