Original Research

# Apical Sealing Ability of Two Recent Root Canal Sealer Using Dye Penetration – A Stereomicroscopic Study

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## ABSTRACT

The proper sealing of root canal system is utmost important objective to achieve the ultimate goal of failure free endodontic treatment. Root canal sealers not merely form a bond between its walls and filling material, it seals foramen and accessory canal too. It entombs remaining bacteria as well as act as a lubricant which help in placing filling core material. Perfect sealing of root canal develops a hermetic seal and prevents penetration of bacteria thus prevent re-infection and reduces the chances of retreatment required for endodontically treated teeth. The aim of this experimental study was to compare the sealing ability of two recent root canal sealers such as **Hybrid root sealer** and **Bio C sealer** on the basis dye penetration method.

**Keywords:** Biocompatibility, Apical micro leakage, Contemporary root canal sealers, Dye penetration.



**Introduction :**

The principal objectives of endodontic therapy are to clean and shaped the root canal system and to fill the entire root canal system in three dimensions.[1] This prevents penetration of bacteria and their products into the periapical tissues and develops a hermetic seal. A variety of materials are available for root canal obturation; however, the gutta-percha cones along with the sealer remain the most accepted choice of the clinician[2]. Different types of sealers have been used in conjunction with gutta-percha for root canal obturation with varied success. It is commonly accepted that micro leakage between the root canal walls and root canal filling might adversely affect the outcome of the endodontic treatment.Consequently, sealing the entire root canal system after cleaning and shaping is of utmost importance to prevent oral pathogens from colonizing and re-infecting the root and periapical tissues[3].According to Grossman,an ideal Endodontic sealers should provide an excellent seal on setting, produce adhesion between filling material and dentinal wall, easy to manipulate, radiopaque ,dimensionally stable, antibacterial and non irritating to surrounding tissues.

Unfortunately, none of the sealers available till now have all the ideal properties of sealer [3]. The ideal root canal sealer must have an ability of effective bonding between core material and dentinal wall to prevent micro-leakage at interface [4, 16, 17]. In endodontic treatment, sealers are principally used to fill the irregularities of the root canal system, to provides lubrication and attach the gutta-percha to the root canal walls[3, 5]. The aim of this study is to evaluate and compare the apical sealing ability of two recent sealers viz., Bio- C sealer and Hybrid Root seal. Hybrid root sealer is a fourth generation self adhesive dual cure sealer available in powder- liquid form[6,7]. The powder contains zirconium oxide as spherical radiopaque fillers, silica nanofillers, and a hydrophilic polymerization initiator [6]. The liquid contains methacrylate. It forms the hybridized dentin which promotes bonding and resists it from acidic challenges that's why it is called as Hybrid Root sealer.

Bio-C sealer [Angelus, Canada] is a bioceramic root canal sealer which is available in ready to use syringes. It can be easily manipulated due to its mechanical and physical properties. Its composition releases calcium ions to stimulate formation of mineralized tissue. Its high biocompatibility and high pH ensures safety and treatment success. Bio-C sealers also possess low solubility thus giving superlative degree of seal, while it is



found to be ideal in setting in moist environment due to its hydrophilic properties. It also possesses excellent flowability and superior handling with thin film application due to its small particle size. Further, it can be used with any obturating material including those involving heat. It can be easily removed from the canal in cases of retreatment. So many studies suggested that such sealers posses couple of advantages over others, firstly its crystalline structure and chemical composition resembles that of tooth and bone apatite which contains calcium phosphate and enhances its setting property. Secondly, it is biocompatible and hence well adopted by surrounding tissues. [8, 18]

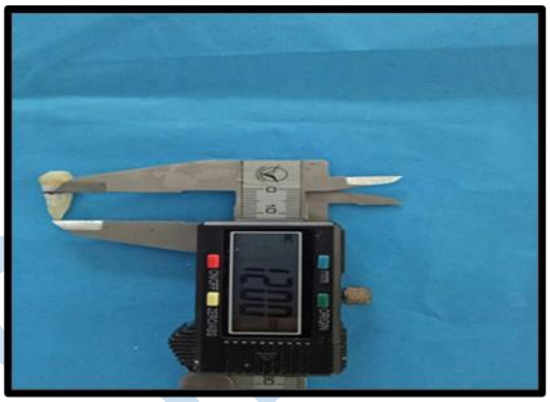
**Materials and method**

**Selection of tooth samples**

In this study, twenty extracted manidibular premolars were selected. The inclusion criteria of this study was that teeth should be intact, single rooted and should not have any internal and external resorption, cracks, calcifications and root caries. (figure-1)

**Tooth samples.**

Decoronation of each sample was done with diamond disc bur in such a way so that equal root length of 12mm is obtained.[9] In order to evaluate working length a size #10 K file was introduced in canal till it was visible at the apical foramen and then 1 mm was subtracted from it. (figure-2)



**Measurement of root length 12mm using digital caliper.**

**Biomechanical preparation and obturation**

Biomechanical preparation of each sample was done with wave one single file rotary system. Samples were randomly divided into two groups.Group A(n=10) samples were obturated with Bio- C sealer and gutta percha cone while in Group B obturation was done with Hybrid Root Seal sealer and gutta percha cone. After this, all samples were stored for 7 days at room temperature to allow the sealer to set. The Roots were coated with two layers of nail polishing varnish, except for apical 2 mm of root tip to avoid the diffusion of dye liquid through dentinal tubules. [10]

**Dye penetration**

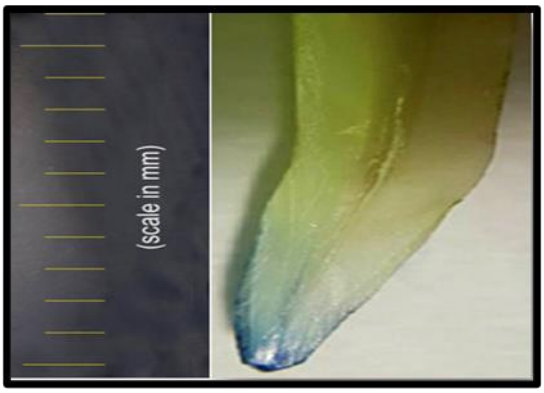
After complete drying of nail varnish, all samples were submerged in 2% methylthioninium chloride solution (methylene blue dye) for 24 hours at room temperature.[11]The root surface was then washed with water to remove excess dye from external surface.[12]

**Vertical sectioning and stereomicroscopic study**

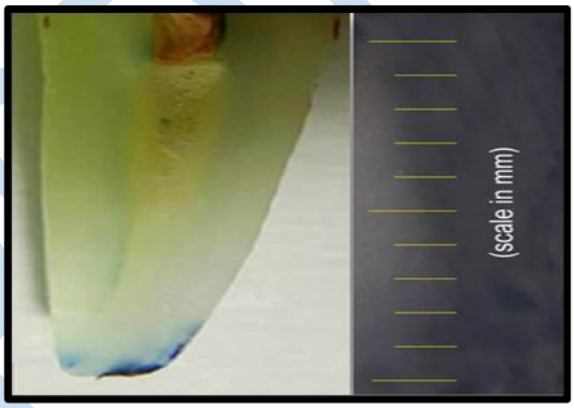
The roots were sectioned vertically along the long axis into two halves.Both halves of each sample thus obtained were screened under a stereomicroscope. Images were taken with a digital camera and a scale which had 1 mm per division had been superimposed to the entire length of vertically sectioned tooth in such a way that 12 mm of root length equals 12 mm of scale division. Blue colored dye penetration was measured by digital caliper on this image and to obtain actual depth of dye penetration by using scale with measured penetration which had reading of 12 mm image. Unitary method was applied to calculate actual dye penetration depth d, which can be calculated by using formula

$$d = \frac{12x}{X}$$

Where x is measured penetration reading on image and X is measured length of entire root image.(Figure-3,4)




**Extent of apical dye penetration in the teeth obturated with guttapercha andhybrid root seal.**




**Extent of apical dye penetration in the teeth obturated with guttapercha and bio C sealer.**

**Statistical analysis**

Statistical analyses of results were obtained using SPSS version 21 for windows and utilizing One Way ANOVA test.

**Result**

The experimental result shows that mean dye penetration value for Group A i.e. Bio C sealer has smaller (2.167 mm±0.129) thus have superior sealing ability as compared to hybrid root seal which have mean dye penetration (4.054 mm±0.977).



The statistically significant difference was p=0.00001, which is well above the 95% confidence limit (Table-1,2).

**Table 1: Measurement of linear dye penetration (mm) in two groups of sealers**

| Sample No | Group A (Bio C sealer) | Group B (Hybrid Root Seal) |
|---|---|---|
| **1** | 1.90 | 2.34 |
| **2** | 2.05 | 2.94 |
| **3** | 2.07 | 3.67 |
| **4** | 2.17 | 3.96 |
| **5** | 2.19 | 4.07 |
| **6** | 2.20 | 4.27 |
| **7** | 2.21 | 4.32 |
| **8** | 2.25 | 4.45 |
| **9** | 2.29 | 4.53 |
| **10** | 2.34 | 5.99 |
| **Mean** | **2.167** | **4.054** |
| **S.D** | **0.129** | **0.977** |

**Table 2: ANOVA analysis of** dye penetration

| | Sum of Squares | DF | Mean Square | F | p |
|---|---|---|---|---|---|
| SSB | 17.82 | 1 | 17.82 | 36.88 | .00001 |
| SSW | 8.70 | 18 | 0.48 | | |
| SST | 26.52 | 19 | | | |

## Discussion

The principle requirement to achieve a successful obturation is to obtain a hermetic seal. In order to achieve such hermetic seal a wide variety of endodontic sealers are available, which includes silicon-based sealers, epoxy resin-based sealers, mineral trioxide aggregate-based sealer, calcium silicate-phosphate-based bioceramic sealer, and methacrylate resin-based sealer[2].

The sealing ability of endodontic sealers can be detected and evaluated by various techniques, but in this study we have utilized methylene blue dye penetration method. Dye penetration method is used due to its inherent advantages in evaluating apical micro-leakage such as; low cost, low toxicity, good availability, and ease of storage.

Between these two experimental groups used in this study, Bio-C sealer with gutta-percha was the better group which showed the lower leakage as compared to hybrid root seal.

Bio- C sealer is a bioceramic sealer composed of tricalcium silicate and zirconium oxide which leaches calcium ions. These calcium ions interact with the physiological fluids to form mineral infiltration zone between the sealer and the root canal wall; which helps in biomineralization activity. This reaction property is responsible for making good seal.

Formation of the hybrid dentin is the major mechanism of bonding for resin based sealers. Hybrid Root Seal [Sun Medical Co. Japan] being a methacrylate based sealers inherently undergo polymerization shrinkage coupled with high C-factor inside the root canals.[13] Immediate light curing



from the coronal side of the roots may also create a large polymerization stress during setting by preventing flow of resin based sealers and may lead to debonding of the resin from the root canal walls, which results in gap formation and subsequently affecting the sealing ability of the sealer[2,14, 15].

**Conclusion**

On the basis of this study and within its limitations, we can conclude that dye penetration examination showed that hybrid root sealer had weak sealing properties to root canal walls in comparison with Bio – C sealer. Till this day, no root canal filling material can accomplish all the requirements for a perfect root canal sealing.

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