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Water Expandable Endodontic Obturation Point–A Review

Krishnan Hari*

MDS, Reader, Mar Baselios Dental College, Kothamangalam, Kerala, India

Review Article

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***For Correspondence:**

Dr. Krishnan Hari, MDS, Reader
Mar Baselios Dental college,
Kothamangalam, Kerala, India,
Tel: 9946102580.

E-mail: lordkrish18@hotmail.com

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ABSTRACT

Proper seal at the coronal, middle and the apical end of a root canal is achieved only if the material has the ability to seal the root canal dentin in all directions. A new self-sealing root canal obturation system called as C-points (EndoTechnologies, LLC, Shrewsbury, MA) based on polymer technology has been introduced which undergoes lateral hygroscopic expansion when in contact with moisture in the root canal. The aim of this review is to provide a basic overview of its composition and properties after analysing few related studies.

INTRODUCTION

The purpose of the obturation phase of root canal treatment is to prevent re-infection of the canal space that has been biomechanically cleaned, shaped and disinfected by instrumentation, copious irrigation and medication procedures that ultimately prevent periradicular disease. It is difficult to consistently and totally disinfect root canal systems. Therefore, the goal of three-dimensional obturation is to provide an impermeable fluid-tight seal within the entire root canal system, to prevent oral and apical microleakage ^[1,2]. Successful obturation requires the use of materials and techniques capable of densely filling the entire root canal system and providing a fluid-tight seal from the apical segment of the canal to the coronal segment of the root canal dentin. The radiographic appearance of a completed case should show the obturation material: (a) at the apical terminus without excessive material overextending into periapical tissues; (b) completely filling the root canal system in three dimensions; and (c) appearing as a dense radiopaque filling of the root canal system ^[3]. Though gutta-percha is commonly used as an endodontic obturation point, its ability to laterally seal the root

canal dentin remains questionable [4]. To overcome this drawback and to improve the quality of obturation, a root-canal obturation point called C-point (EndoTechnologies, LLC, Shrewsbury, MA), also known as Propoint was introduced that is a part of the Smartseal™ (known as Prosmart™ outside UK) obturation system which is used along with Smartpaste Bio (Smartseal™) or HySeal-bio.

Structure of C- point

The C-point system (EndoTechnologies, LLC, Shrewsbury, MA, USA) is a point-and-paste root canal filling technique that consists of pre-made, hydrophilic endodontic points and an accompanying sealer.

C-points (**Figure 1**) have a two-component design, a central core to provide good handling characteristics and a hydrophilic polymer coating, which radially expands to seal the canal. When hydrated in the root canal, C-points expand, conforming to canal irregularities and pressing the companion hydrophilic sealer, HySeal-bio (**Figure 2**), into concavities, lateral portals of exit and the tubules of the dentin walls (**Figures 3 and 4**) [5].

The inner core of C-point is a mix of two proprietary nylon polymers: Trogamid T and Trogamid CX (**Figure 1**).

The polymer coating has a hydrophilic and hydrogel layer which has controlled expansion and biocompatibility. It is a cross-linked copolymer of acrylonitrile and vinylpyrrolidone, which has been polymerized and cross-linked using allyl methacrylate and a thermal initiator. The lateral expansion of C-point is claimed to occur non-uniformly, with the expandability depending on the extent to which the hydrophilic polymer is pre-stressed (i.e., contact with a canal wall will reduce the rate or extent of polymer expansion) [6,7]. This mechanism of lateral expansion of the obturation point reduces the possibility of reinfection and enhances the success of root canal treatment. C-points are capable of achieving a relatively good fit inside the root canal, however, it is mandatory to use the accompanying sealer (Smartpaste Bio (SmartSeal™/HySeal-bio) to seal the remaining spaces between the expanded point and the root canal dentin (**Figure 1**).

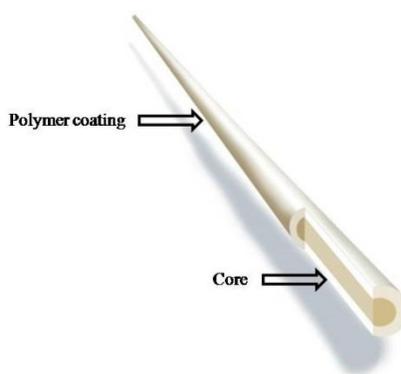


Figure 1. Structure of C-point.



Bioceramic Sealer

Figure 2. HySeal Bio.



Figure 3. Pre-operative radiograph of mandibular first molar.



Figure 4. Post-operative radiograph of the tooth with C-point.

The deformable endodontic point (C-point) is available in different tip sizes and tapers and is designed to expand laterally without expanding axially, by absorbing residual water from the instrumented canal space and that from naturally-occurring intraradicular moisture [8].

Smartpaste Bio

It is a biocompatible resin based sealer which uses bioceramic as one of its constituents to improve the dimensional stability and render it non-resorbable inside the root canal. Smartpaste Bio (Figure 5) produces calcium hydroxide and hydroxyapatite as byproducts of the setting reaction, rendering the material both

antibacterial while setting and very biocompatible once set. The delayed setting time, and the hydrophilic nature of the cement makes this a perfect companion to use with self-sealing Propoints (Smartseal™) (Figure 6), allowing the point to hydrate and swell to fill any voids [9].



Figure 5. Smartpaste bio (sealer).



Figure 6. Propoint S.

The sealant is delivered in a pre-mixed syringe and does not require mixing as it can be applied directly into the canal using an intra-canal tip minimizing wastage of material. The cement absorbs water from within the canal and once set, Smartpaste Bio produces a radiopaque biocompatible cement [7,9].

Propoint S

The Propoint S (Figure 6) range is the newest addition to the Propoint family. They work in exactly the same way as the original Propoints except the range is designed to precisely fit the variable taper profiles generated by the Sendoline S5* file system to ensure that an effective seal is achieved. Propoint S is available in sizes S2 through to S4 to match the final file taken to full working length [9].

Accessories Required Before and During Obturation

1) **Smart Trim:** The kit contains two long-flame gold burs and two pear diamond burs, since heat cannot be used on Propoints to remove the excess material. Use the flame bur on a high-speed to remove the excess and then push down on the top with the pear bur until the Propoint is flush with the orifice [9].

2) **Smart Gauge:** It is an autoclavable measuring block (**Figure 7**) designed to trim the 4% and 6% taper Propoints to the apical desired size. The manufacturer recommends trimming of the Propoint to one size less to that has been prepared. For example, if the root canal has been prepared to size 40, then the Propoint can be trimmed to a size 35. Trimming is done by pushing the point through the corresponding hole in the smartgauge and cutting off the excess with a scalpel [9].



Figure 7. Smartgauge.

Canal Irrigation

Prosmart points are compatible with all of the common irrigation techniques. As with all root treatment techniques, copious irrigation is essential; however, excess irrigant should be removed with paper points.

Canal Obturation

- 1) Simply choose the Propoint that matches the size of the final file used to complete the canal.
- 2) Try in a matching Propoint to ensure it reaches full working length and you have tug-back. If the point does not go to length then either use the final file again to ensure adequate shape or use a smaller size Propoint.
- 3) Take a radiograph to confirm the position of the point.
- 4) Place the sealer into the canal. The sealer can be introduced into the coronal two-thirds of the canal using the provided syringe tips.
- 5) The Propoint is introduced into the canal to the working length using tweezers.
- 6) The Propoint can be trimmed to the level of the canal orifice using a high-speed handpiece and a diamond bur. This is available in the SmartTrim trimming Kit.

DISCUSSION

The Propoint polymer is hydrophilic which allows the minute amount of water present in the root canal to be absorbed by the points. This water can hydrogen bond to the polar sites present, enabling expansion within the polymeric chains. The rate and extent of this expansion is controlled as part of the manufacturing process. Known as hydrogels, polymers of Propoint, expand with a miniscule force that is well below the reported tensile stress of dentine and a fraction of the force generated when using traditional techniques such as warm vertical compaction. This gentle expansion occurs within the first four hours after placing the point into the canal and allows the point to gently adapt to any irregularities in the root canal. This results in the polymer and sealer being expressed into the dentinal tubules. The slight positive pressure against the canal wall that is created forms a seal that is virtually impermeable to bacterial microleakage [10]. A study by Didato A et al. revealed that, lateral hygroscopic expansion of water-expandable obturation point increased significantly when compared to gutta-percha after a period of 20 minutes [4]. An ex vivo comparison of the push-out bond strength of Propoint (Smartseal™) and various gutta-percha filling techniques revealed no difference in adhesion to dentine between the Smartseal™ system and gutta-percha/AH-26 applied using either the single cone or lateral condensation technique [11]. A study by Eid AA et al revealed that the in vitro biocompatibility of C-point is comparable to gutta-percha with minimal adverse effects on osteogenesis after elution of potentially toxic components [12].

CONCLUSION

Considering the composition and properties of this water-expandable obturation point, it could be a solution to many of the obturation drawbacks like coronal and apical leakage and can be considered as an applicable alternative to gutta-percha. Most of the recent studies done on water-expandable obturation points are in vitro, need and necessity calls for more clinical studies to establish its long-term use.

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