Smartseal: New Age Obturation

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Abstract

Smartseal is a recently introduced root canal obturating system based on polymer technology. Its principle is based on the hydrophilic nature of the obturating points which can absorb surrounding moisture and expand resulting in filling of voids and spaces. Since, its introduction, Smartseal has been widely reported to be successfully used in endodontic therapy. This article aims to provide a brief overview of this product with a mention of a few related studies.

Key Words: - Gutta-Percha, Obturation, Root Canal Therapy, Smartseal

Introduction

In recent years, the field of endodontics has taken major strides in various aspects, be it the operating microscope or a wide range of file systems and irrigation regimens. Despite these several advances, the materials and the methods of obturating root canal have not significantly changed. In a study performed to investigate current endodontic clinical practice among 702 primary care dentists in the north west of England, it was found that lateral condensation technique was the popular obturation method among majority of them (Palmer et al., 2009).[1]

Attempts made to modify the usage of gutta percha have largely failed due to expensive equipment, technique sensitivity or material not compatible for human use. To overcome these problems and improve the treatment outcome, a root canal obturating system called Smartseal™ (known as Prosmart™ outside UK) was developed. This product is considered to exhibit smart behavior and incorporates developments in hydrophilic polymer plastics. Smartseal is a two-part system consisting of:

1. Propoint
2. Smartpaste/Smartpaste Bio

Propoint

Also known as C points, these obturation points are constructed in two parts:

Central Core: It consists of a combination of two proprietary nylon polymers, Trogamid T and Trogamid CX. It is considered to provide the point with the flexibility to allow it to easily pass around any curves in the prepared canal, while being rigid enough to pass easily to length in narrower canals.

Outer Polymer Layer: It consists of a cross-linked copolymer of acrylonitrile and vinylpyrrolidone, which has been cross-linked using allyl methacrylate and a thermal initiator. This hydrophilic, hydrogel layer allows the point to swell in order to adapt to the ramifications of the root canal. This coating is designed to swell laterally, thereby self-sealing the canal. It does not swell axially so there is no length change and radial swelling stops once a seal is created.[2]

Mechanism of Controlled Expansion

The hydrophilic nature of propoints may allow 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. The expansion occurs with a miniscule force that is claimed to be 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 4 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 believed to be virtually impermeable to bacterial micro-leakage.[2]

One propoint covers all tip sizes and it is available in the following sizes:

6% taper - ISO tip sizes 25 to 45
4% taper - ISO tip sizes 25 to 45
ProTaper™ - F1, F2, F3, F4 & F5
Sendoline™ S5 - S2, S3, S4. (Figure 1)

Figure 1: Propoints: S range

Smartpaste

Smartpaste is a resin based sealer containing an active polymer that swells to fill any voids or cavities in the root canal. The degree of swelling is controlled by the amount of active polymer used. The polymer can also swell at a later date to fill any voids that might develop.

It is dispensed in a syringe to ensure an accurate ratio of sealer components is achieved every time and mixing/dispensing trays are provided to aid application.[2]

Smartpaste Bio

Smartpaste bio is a resin based sealant designed to swell through the addition of ground polymer. The manufacturer claims that the addition of bioceramics, gives the sealer exceptional dimensional stability and makes it non-resorbable inside the root canal. Smartpaste bio produces calcium hydroxide and hydroxyapatite as by-products of the setting reaction, rendering the material both anti-bacterial while setting and very biocompatible once set. Also, it has a delayed setting time (4-10 hr), and is hydrophilic in nature, allowing the propoint to hydrate and swell to fill any voids.

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 minimising wastage of material. (Fig 2) The cement absorbs water from within the canal and once set smartpaste bio produces a radiopaque biocompatible cement.[2]

Figure 2: Smartpaste Bio

Accessories

Smarttrim

It consists of a kit of 2 long flame gold burs and 2 pear diamond burs for trimming the excess amount of propoints.

Directions of Use:

- 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.
- Water maybe kept on if smartpaste is used, as it is hydrophilic.
- If using smartpaste bio, burs must be kept dry or the water may wash away much of the sealer.

Smartgauge

It is a measuring block designed to trim the 4% and 6% taper propoints to the apical desired size.

It reduces the need to carry large stocks of pre-trimmed points and also allows a custom fitting.

Directions of Use:

The manufacturer has recommend trimming to one size less to that has been prepared, i.e. if a size 40 has been prepared, 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.

The points are rigid enough to be nibbled at the apex a snug fit is felt with positive tug back at the correct working length.

The smartgauge is autoclavable at the usual settings.

Obturation Technique:

1) Select the correct prosmart point. Simply choose the Propoint that matches the size of the final file used to complete the canal.

2) Try in the selected propoint: Try in a matching ProPoint to ensure it reaches full working length and you have tug-back. If the point passes beyond the working length then simply trim the apical portion to the correct length with scissors. 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) Use an apex locator or take a Radiograph to confirm the position of the propoint.

4) Place the Sealer: SmartPaste Bio is a pre-mixed sealer paste. The sealer can be introduced into the coronal 2/3 of the canal using the provided syringe tips.

5) Place the ProPoint: The propoint is introduced into the canal to the working length using tweezers. A slow firm pressure is required to allow the point to evenly distribute the sealer down into the canal.

6) Trim the ProPoint: The propoint can be trimmed to the level of the canal orifice using a highspeed handpiece and a diamond bur. This is available in the SmartTrim Trimming Kit.

7) The tooth can then be restored immediately using any conventional restorative material.

Related Studies

Economides et al (2011) evaluated, ex vivo, the push-out bond strength of Smartseal compared with gutta-percha/AH-26 in 40 extracted single-rooted human teeth. After instrumentation using the ProTaper rotary system, the root canals were filled as follows: Group 1, Smartseal sealer and a 0.06 taper Smartpoint calibrated to apical tip size 30; Group 2, Smartseal sealer and an F3 SmartpointPT; Group 3, AH-26 sealer and a single F3 ProTaper gutta-percha cone and Group 4, AH-26 sealer and gutta-percha using the cold lateral condensation technique. Statistical analysis revealed no significant differences ($p > 0.05$)

between the mean bond strengths of the various groups; thus indicating there was 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.[3]

Eid et al (2013) evaluated the biocompatibility of C Point and commercially available gutta-percha points using a rat odontoblast-like cell line (MDPC-23) by measuring cell viability and mineralization potential of MDPC-23 cells. C Point showed higher initial cytotoxicity compared with gutta-percha and Teflon ($P < .05$), which became nonsignificant after 4 immersion cycles. Significant differences were also found between eluents from C Point and gutta-percha at 1:1 concentration ($P < .05$) but not at 1:10 or 1:100 concentrations. Both materials induced minimal apoptosis-induced alteration in plasma membrane permeability. Compared with the Teflon negative control, C Point and gutta-percha groups showed upregulation of most osteogenic gene markers except for dentin sialophosphoprotein, which was downregulated. Alkaline phosphatase activity and alizarin red assay for C Point and gutta-percha were both significantly higher than for Teflon but not significantly different from each other ($P > .05$). Transmission electron microscopy showed discrete nodular electron-dense mineralization foci in all 3 groups. They concluded 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.[4]

Didato et al (2013) compared the time-based lateral expansion of two sizes (25 and 40) of C Point obturation points with a similar-sized gutta-percha point (control) at various distances from the point apex: 5, 10, and 15 mm. under 50 X magnification, using a binocular microscope. Changes in C Point dimension were significantly higher for both sizes at each tip distance after 20 min of water immersion but gutta-percha did not significantly change from the dry value during water immersion.[5]

Conclusion

The development of materials such as Smartseal may prove to be a game changer in the field of endodontics. One of the main advantages of this obturating system is the versatility of the product allows the creation of points to match most file systems present today. The use of Smartseal in conjunction with the latest equipment and techniques available in endodontics will further enhance the root canal treatment outcomes.

References

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