**RECENT ADVANCES IN ROOT CANAL SEALERS**

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**ABSTRACT**

Chief objective of endodontic therapy is obturation with an inert, dimensionally stable and biologically compatible sealer of prepared root canal system which will deliver a hermetic seal by binding to all walls of the canal. Its use is of significance as a three-dimensional seal of the canal space is achieved with the help of sealer during obturation of the canal 4. Core obturation material, such as gutta-percha points, slides in and become fixed in the canal as sealer functions as a lubricant and luting agent during obturation. New advancements have been used to develop sealers that have much better properties and are biocompatible with the dentin. Bioceramic sealers have changed the face of endodontics. The present review focuses on the recently introduced sealers and discussion regarding its properties.

**Keywords:** Root canal sealers, NanoSeal-S, ThermaSeal Plus Ribbon, BIO-C SEALER, NeoSEALERFlo

**INTRODUCTION**

Aim of Endodontic treatment is to retain clinically compromised tooth, thereby preserving its physiological position with form and function. It has become prevalent due to better and predictable success rate of endodontic procedures 1. Various crucial factors like appropriate instrumentation, cleaning and shaping, obturation, and finally the post-endodontic restoration is attributed to success of ideal root canal treatment 2. An essential objectives of endodontic therapy is obturation of the prepared root canal system with an inert, dimensionally stable and biologically compatible material and inhibit the microbial entity and any future predilection of re-infection, thus provide a three dimensional fluid tight seal. Numerous materials have been used in root canal therapy but gutta-percha is universally accepted as the “gold standard” for the obturating materials 3. Sealer is an exceptionally important component of the root canal obturation in order to achieve three-dimensional sealing of the canal space 4. Sealers are used as a thin tacky paste which functions as a lubricant and luting agent during obturation, allowing the core obturation material, such as gutta-percha points or other rigid materials, to slide in and become fixed in the canal. Sealer along with solid obturating material performs synergistically to create hermetic seal 4. Recently, numerous novel root canal sealers were introduced under various commercial names. Addition of various agents helps to attain tissue-remineralization and antibacterial properties refining the biocompatibility and bioactivity characteristics of sealers 5. Knowledge about properties and features of an endodontic sealer is important to determine the best choice and application for each clinical case. Although limited materials are capable enough to swap GP on multiple parameters, research continues to find alternatives that may seal better and mechanically reinforce compromised roots by forming monoblock, This reduces bacterial ingress pathways and support the root to some extent 2.

**NanoSeal-S** 6

NanoSeal-S (FIG 1)is a cold flowable polydimethylsiloxane based, antimicrobial root canal sealer fortified with nano silver which is self-curing. Nano silver increases the anti-bacterial effectiveness and acts as a preservative. Composition includes polydimethylsiloxane, silicone oil, nano silver, nano zirconium dioxide, platinum catalyst and excipients. It enlarges by 0.2% to give a tight seal. Rod-shaped active nanoparticles can infiltrate the dentinal tubules and go into accessory canals to confirm all the spaces are successfully sealed. Micro-silver particles are dispersed equally in the sealer and in chemical form and so it will not cause corrosion or color changes.



FIG 1: NanoSeal-S

**ThermaSeal Plus Ribbon Root Canal Sealer** 7

ThermaSeal Plus Ribbon root canal sealer is a dual paste system consisting of epoxy-amine resin with long lasting sealing and self-adhesive nature. Paste A which is amber in color consist of Bisphenol-A epoxy resin, Calcium tungstate,Zirconium oxide, Silica, Bisphenol-F epoxy resin, Iron oxide pigments.Paste B having a white color consist ofZirconium oxide, Calcium tungstate, Dibenzyldiamine, Silica, Aminoadamantane, Tricyclodecane-diamine, Silicone oil. Advantges include high Radiopacity **,** low Micro-Leakage**,** high dimensional stability **,** low shrinkage, low expansion, low Solubility**,** excellent sealing properties, **s**elf-adhesive properties, biocompatibility .

**BioRoot RCS** 8

BioRoot RCS (FIG 2) is the newest endodontic mineral based root canal sealer containing tricalcic silicate ingredients aiding from both Active Biosilicate Technology and Biodentine. It is a hydraulic tricalcium silicate based cement suggested for single cone technique or cold lateral condensation root filling. It contains a powder and a liquid. The powder is composed of tricalcium silicate, povidone and zirconium dioxide, and the liquid consist of calcium chloride, polycarboxylate and water. It continues the sealing process in presence of moisture. Dentin is mineralized by hydroxy-apatite formation. It has microleakage resistance over warm obturation technique. BioRoot RCS crystalizes within dentinal tubules creating a 3-dimensional seal and leakage-free obturation . Its high pH (>11) creates a favorable alkaline environment. Pure mineral formulation will not stain teeth. Resin-free and monomer-free nature ensures zero shrinkage. Eugenol-free nature makes it compatible with all bonding systems. Great flowability plugs auxilliary canals. Appropriate for use in cold single cone or cold lateral condensation and permits quick insertion of the gutta-percha points in permanent tooth.



FIG 2: BioRoot RCS

**GuttaFlow Bioseal** 9

GuttaFlow bioseal is a cold filling silicone-based sealer comprising bioactive glass and gutta percha powder. Gutta percha with bioactive glass forms crystals of hydroxyapatite on the surface. GuttaFlow is a 2-in-1 cold filling (obturater and sealer in one) obturation system that is used for the obturation of root canals. Composed of Polydimethylsiloxane, Gutta-percha powder, Platinum catalyst, Silver (preservative), Zirconium dioxide, Bioactive glass ceramic and coloring agent. GuttaFlow also demonstrations exceptional adhesion to the gutta-percha point (masterpoint) in addition to to the dentine wall and does not require condensation as it expands on its own.

**BIO-C SEALER** 10

BIO-C SEALER (FIG 3) is a ready-to-use bioceramic endodontic cement that is ready-to-use. Its easy to apply on the canal, shortening the procedure with good time saving. It promotes a biological seal in addition to the physical seal provided by the expansion of cement by the formation of an intermediate layer of mineralization. It consists of Tricalcium Silicate (C3 S), Tricalcium Aluminate, Dicalcium Silicate (C2 S), Calcium Oxide, Silicon Oxide, Zirconium Oxide, Iron Oxide and Polyethylene Glycol. Its Radiopaque and has pH of 12. The interaction of BIO-C SEALER with moisture and tissue fluids discharges active ions that interact with the organic and inorganic matrix of the dentin, encouraging the development of an intermediate area, called the Mineral Infi ltration Zone.This zone of mineral infiltration in the dentin delivers an excellent biological seal, diminishing likelihoods of bacterial infiltration.



FIG 3: BIO-C SEALER

**CeraSeal** 11

CeraSeal is a calcium silicate-based root canal sealer which delivers optimum biocompatible environment in the root canal. Due to its excellent sealing ability and biocompatibility its considered next generation bioceramic-sealer. Its composed of Calcium silicates, thickening agent, zirconium oxide. Calcium silicate creates CAH (Calcium Aluminate Hydrate) gel and CSH (Calsium Silicate Hydrate) gel by absorbing the moisture from tissues in the root canal and crystallization of Calcium Hydroxide (Ca(OH)2). It is antimicrobial and highly biocompatibile attributed to the presence of Calcium Hydroxide (Ca (OH)₂)'s plus its high pH. Its volume remains same and so it does not expand or shrink in the root canal.

**AH Plus Bioceramic Sealer** 12

AH Plus Bioceramic Sealer (FIG 4) is a root canal sealer conforming to ISO 6876 which does not require any pre-mixing as it comes in a pre-loaded syringe and is set by absorbing moisture from the root canal environment. The sealer may be used either alone or in combination with gutta-percha obturating cones, injected gutta-percha material or core-carriers master cones. It’s composed of Tricalcium silicate, Zirconium Dioxide, Lithium carbonate and Dimethyl sulfoxide. Sealer does not discolor the tooth and guarantees a confident smile as its free of Bismuth Oxide. Retreatability is decent as its removable even after setting with a general hand file or NiTi file. It delivers an ideal environment for hydroxyapatite formation paving the way for the body’s self-healing process.



FIG 4: AH Plus Bioceramic Sealer

**NeoSEALERFlo** 13

NeoSEALERFlo is a bioactive bioceramic sealer easy to handle, promotes hydroxyapatite formation which supports the healing process**.** Unlike conventional sealers, neosealer Flo is resin-free, biocompatible, antimicrobial, dimensionally stable comprising of particularly fine, inorganic powder of tricalcium/dicalcium silicate in an organic medium. It releases calcium and hydroxide ions from the MTA, encouraging hydroxyapatite development on the MTA surfaces to enhance sealing and support healing. High pH to promote osteogenic response.

**EDGE BIOCERAMIC SEALER** 14

Edge BioCeramic Sealer (FIG 5) consist of a unique resin-free formula making it very biocompatible and hydrophillic. Contrasting conventional sealers, Edge Bioceramic Sealer does not shrink and therefore it does not have to be compacted. It is radiopaque, insoluble and aluminum-free material based on a calcium silicate composition, which necessitates the presence of water to set and harden. It consist of Tricalcium silicate, Dicalcium silicate, Zirconium oxide and Calcium hydroxide. EdgeBioCeramic has high push-out bond strength and forms a close-fitting seal in the root canal thereby decreasing the likelihood of bacterial recolonization. Its Radiopaque and hydrophilic.



FIG 5: Edge BioCeramic Sealer

**CONCLUSION**

All these years, there has been an evolution of sealers used in the root canal, starting from conventional Zinc oxide eugonel to the current ones like epoxy-resin based sealer, and to the most modern bioceramic sealers, which have the predilection to change the way sealers have been used in the near future 2. However till date, no sealer has been presented to be completely suitable for clinical use. Novel endodontic root canal sealers reported in the recent literatures exhibits encouraging biological features in comparison to conventional ones 3. Bioceramic sealers are more biocompatible and better accepted by the root canals. Few of them are even able to promote osteoblastic differentiation. Further in vitro and in vivo studies should be performed to confirm the sustainability of recently available sealers, for their clinical use, as more investigations would help us to illuminate the mechanisms causative to the observed beneficial results 5.

**REFERENCE**

1. **Cohen S, Burns Richard C.** Text book of pathways of pulp: Obturation of cleaned and Shaped Root Canal System. 2002, the Mosby Company, 8th Edition; 293-95
2. **Tyagi S, Mishra P, Tyagi P.** Evolution of root canal sealers: An insight story. Eur. J. Gen. Dent. 2013;2(03):199-218.
3. **Mishra P, Gupta S, Nikhil V, Jaiswal S, Raj S.** Root canal sealers: A review. Indian J of Conserv Endod. 2020:15;3(3):69-74.
4. **Abu Zeid ST, Alamoudi RA, Mokeem Saleh AA.** Impact of Water Solubility on Chemical Composition and Surface Structure of Two Generations of Bioceramic Root Canal Sealers. Appl. Sci.2022;12(2):873.
5. **Özdemir O, Kopac T.** Cytotoxicity and biocompatibility of root canal sealers: A review on recent studies. J. Appl. Biomater. Funct. Mater. 2022;20:22-25.
6. **NanoSeal-S** [pamphlet]. India: PREVEST DENPRO LIMITED; 2016
7. **Ribbon® Root Canal Sealer** [pamphlet]. Germany: Tulsa Dental Specialties DENTSPLY International, Inc; 2016
8. **BioRoot™ RCS** [pamphlet]. France. SEPTODONT; 2016
9. **GuttaFlow® bioseal** [pamphlet]. Germany. Coltène/Whaledent Ltd; 2016
10. **BIO-C® SEALER** [pamphlet]. Brazil:Angelus dental***;*** 2018
11. **CeraSeal** [pamphlet]. Korea. Meta Biomed Co., Cheongju; 2020
12. **AH Plus® Bioceramic Sealer** [pamphlet]. USA. DENTSPLY TULSA Dental; 2021
13. **NeoSEALERFlo** [pamphlet].USA: Avalon biomed, Texas: 2021
14. **Edge BioCeramic** [pamphlet].USA: Edge Endo: 2022

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