



BIOCERAMIC SEALERS-AN ASSET OR A LIABILITY: A REVIEW ON RETREATABILITY.

Dentistry

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ABSTRACT

Root canal treatment is a time- tested procedure with predictable success rates. However, failures do occur due to various reasons warranting retreatment. The main aim of retreatment is to remove all the micro-organisms and the obturating materials. Recent years have seen emergence of newer endodontic sealers, also known as bioceramic sealers(BCS) owing to their biocompatibility. They are gaining popularity as they possess favorable mechanical properties also, there is still dearth of evidence regarding their removal efficacy in cases requiring retreatment. This article aims to comprehensively review the retreatability of BCS. Review was done based on Pubmed search of relevant articles in last 10 years using "Bioceramic Sealers", "retreatment" as keywords. Relevant cross-references were also scrutinized.

KEYWORDS

Bioceramic Sealers, Retreatability.

INTRODUCTION

Non- surgical retreatment is the procedure of choice for endodontic failures. Retreatment involves removal of obturating material to allow drainage and disinfection of root canal system. Gutta percha in conjunction with sealers is the most common root canal filling material. Many types of sealers are being used these days in endodontic practice. Recently, Bioceramic sealers(BCS) were introduced in 2007 and since then they are gaining popularity as an ideal root canal sealer.^{2,3} They are biocompatible, provide high pH, ensure tight seal and are non-soluble.

On the other hand, there is apprehension amongst a group of clinicians regarding their ability to be removed in retreatment cases. Studies have shown that for success of retreatment all the filling remnants should be removed as it may hinder irrigants to reach the complexities of root canal system.⁴ Proper retrieval of obturating materials also helps to attain apical patency. It has been shown that most of remnants after retreatment are of sealer origin. Studies show that their complete removal cannot be achieved with any retreatment method. There is paucity of literature related to retreatability of Bioceramic sealers.⁵⁻¹¹ This article aims to review the retreatability of bioceramic sealers. Pubmed search was undertaken for articles with the keywords "bioceramic sealers" and "retreatment". Studies were reviewed to compare retreatability of BCS versus AH Plus and other sealers. Efficacy of various retreatment methods, and methods used for evaluation of residual sealers were also reviewed.

Properties: First Bioceramic sealer to be introduced was iROOT SP (EndoSequence BC Sealer), followed by its more purified version BioRootRCS.^{3,12} It comprises of two parts; fine powder (tricalcium silicate and zirconium oxide) and liquid solution (calcium chloride). It utilizes the inherent moisture in dentinal tubules to form calcium silicate hydrate gel and portlandite¹³. The latter reacts with phosphate ion containing dentin and forms hydroxyapatite. Formation of hydroxyapatite confirms the bioactivity of these sealers.¹⁴

Studies also exhibit resin tags with in the dentinal tubules. It is speculated that tubular penetration, chemical bond formation and micromechanical anchorage creates a strong bond between sealer and dentin.¹⁵ This may result in hindrance with complete removal of sealers from the root canals.

The studies on its retreatability considered various parameters for evaluation-

1. Ability to reach working length(WL).
2. Attainment of Apical patency.
3. Time taken to reach Working length/ complete retreatment procedure.

Studies were also reviewed with regards to various techniques used to

evaluate the amount of remnants. Main techniques used were Digital radiography, Scanning electron microscopy (SEM), Confocal microscopy, Micro CT and Optical microscopy.

Ma J. et al.(2012) used digital radiography as an evaluation tool. Digital radiographs are not much favoured as they give only two dimensional information and can not accurately measure the total canal area. Another disadvantage is interobserver variation as they allow only subjective evaluation.¹⁶

Also evaluation by radiographs requires vertical sectioning of tooth and some amount of filling remnants may be lost during the root splitting.¹⁷⁻¹⁹

SEM can qualitatively assess the remnants in canal system. Hess et al. , Kim et al. and Simsek et al. used SEM to assess the cleanliness of dentinal tubule.^{18,20,21} Suk et al. and Zuolo et al. used Micro CT that can qualitatively measure the remnant amount and is reproducible also^{22,10}. Confocal microscopy is the best evaluating method as it can distinguish between gutta percha and sealer and also depicts accurately the penetration of sealer into dentinal tubules.²³

Retreatability: Comparison between different sealers

Various studies have compared retreatment efficacy of Bioceramic sealers with other available sealers in clinical use.

Hess et al.(2011)¹⁸, Kim et al.(2015)²⁰, Oltra et al.(2017)²⁴ compared the retreatability of AH Plus sealer and EndoSequence BC sealer. Hess et al. found BC sealer to be difficult to remove than AH Plus. Similar results were reported by Oltra et al.

Simsek et al.(2014) compared retreatability of AH Plus sealer and iROOT SP sealer in 60 single rooted premolars.²¹

Suk et al. (2017) used AH Plus ,Endosequence BC Sealer and MTA Fillapex and evaluated their retreatability profile. The study was done in 36 upper lateral incisors and lower premolars. They did not find any significant difference in retreatability of BC Sealer and AH Plus sealer. MTA Fillapex was comparatively easily removed.²²

Ersev et al. compared retreatability of AH plus and Endosequence BC sealer in 120 palatal roots of upper molars.²⁵

Donnermeyer et al. reported that AH Plus was associated with more debris on retreatment as compared to Bio Root RCS and MTAfillapex.²⁶

The variability of results across various studies is speculated to be because of use of different obturation techniques and variations in root canal anatomy such as canal curvature and cross-section.

Use of solvents for retreatment

Studies using Chloroform as dissolving material have yielded contradictory results in reducing the amount of BC sealer in canals.

Hess et al concluded that chloroform as a solvent when used with conventional retreatment techniques was not able to fully retrieve BCS thus warranting need for a new solvent to be developed.¹⁸

Oltra et al reported that retreatment efficacy of BC sealer and AH Plus sealer was unaffected by use of chloroform during retreatment.²⁴

Different retreatment techniques

Various studies have compared Rotary and Hand file system for removal of sealers and no significant statistical difference was found between two systems.

Protaper Universal retreatment system and manual files were found to be equally effective in removal of EndoSequence BC Sealer.¹⁶ Similar results were noted for TRUShape and Reciproc file systems.¹⁰

Suk M et al. (2017) found no significant difference in results with use of ESI tips or rotary system.²² Oltra et al. evaluated the effect of Photon Induced Photoacoustic Streaming (PIPS) which was found to significantly reduce the amount of EndoSequence BC Sealer remnants from canals.²⁴

DISCUSSION:

Almost all studies that were reviewed examined the canal cleanliness after retreatment as a measure of success of retreatment procedure. Other factors studied were ability to reach working length (WL) and achieve Apical Patency (AP).

Various researchers have evaluated retreatability in terms of ability to reach WL. WL attainment was significantly lower for BC sealer group as compared to AH Plus Sealer in study by Hess et al.¹⁸ Contradictory results were reported by Agrafioti et al. in study including AH Plus, TotalFill BC Sealer and MTA Fillapex.²⁶ Oltra et al in their study showed 93% recovery rate of WL in BC sealer group.²⁴

Apical foramen patency was achieved in almost all specimens obturated with gutta percha and BC Sealer in three studies that were reviewed.^{23,27,28} Zuolo et al. could not assess apical foramen in 15% of specimens in BC Sealer group.¹⁰ Apical patency recovery rate was reported to be about 80% in different studies.¹⁸

Studies have compared retreatment efficacy in terms of retreatment time also. Some studies found that the time for retreatment was significantly longer for BC sealer.^{18,26} Contradictory results were reported by some researchers.²⁷ Kim et al. did not find any significant difference in retreatment time for BCS and AH Plus sealer.²⁰ These variations can be explained by different obturation and retreatment techniques used among the studies. However, most studies showed satisfactory removal of BCS irrespective of the time spent on retreatment.

CONCLUSIONS

The results of various studies are variable. Contradicting results may be due to use of different methodologies and variations in dental anatomy of various samples. All studies concluded that complete removal of sealer was not possible both in case of BCS and other endodontic sealers. Hand and machine driven files could not help much in retreatment for all groups of endodontic sealers. Same is true for use of solvents but PIPS was found to be effective in retreatment of filling materials though absolute removal was still not possible. Though complete removal of BCS was not possible in most ex vivo studies, WL was attained and apical patency could be achieved to a satisfactory level. So clinically the retreatability of BCS can be considered manageable and satisfactory. But review of existing literature reflected a dearth of studies simulating retreatment indications as most studies are in vitro. So further studies need to be carried out to formulate better retreatment protocols for Bioceramic sealers so they can be used more widely in endodontics without the fear of failure of retreatment, if required.

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