

## **Comparative Evaluation of the Different Retrograde Filling Materials Bioceramic, Biodentine and Mineral Trioxide Aggregate for Endodontic Surgery: A Systematic Review**

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### **Abstract**

**Background and Objective:** The endodontic surgery presents challenge for endodontic outcome. With regard to the clinical relationship between endodontic treatment and retrograde filling materials; we must understand that surgical endodontic treatment is one of the clinical treatment options and lifestyle change that the patients go through. Among the techniques indicated, retrograde filling material is one of the common techniques performed to obtain a tight apical sealing. The aim of current review is to collect all updated and available studies including imperative information concerning the three different retrograde filling materials following endodontic surgery.

**Material and Methods:** Two automated databases (Google Scholar and PubMed using English-language literature) were used for this systematic review, using specific keywords together with inclusion and exclusion standards. The electronic search was done in December 2018 and updated in June 2019. Data about retrograde filling materials were extracted and analyzed.

**Results:** Our inquiry uncovered seven studies that met the exclusion and inclusion criteria. These studies investigated the three different retrograde filling materials following endodontic surgery.

**Conclusion:** Bioceramic compared with MTA and Biodentine had the best retrograde filling material over all other filling materials and more investigations should be performed regarding that.

**Keywords:** Evaluation; Retrograde Filling; Endodontic Surgery; Bioceramic; Biodentine; Mineral Trioxide Aggregate

### **Abbreviations**

IRM: Intermediate Restorative Material; MTA: Mineral Trioxide Aggregate; BP-RPM: BP Plus Root Repair Material; BCRR: Bioceramic Root Repair Material; Super EBA: Super Ethoxybenzoic Acid

### **Introduction**

The main objective of any endodontic treatment whether performed in regular method (non-surgical) or (surgical) is three dimensional filling that maintains apical seal and follows the original root geometry [1]. The airtight apical seal is very hard to be gain without overfilling as a result of eliminating the apical constriction [2]. Moreover, the existence of thin apical root thickness provides a significant risk to root fracture [2]. Endodontic surgery is an option to avoid tooth extractions when conventional endodontic therapy has failed [3]. The target of endodontic surgery is to gain access to the periapical lesion, assess the root circumference, and place a biocompatible retrograde filling material that stimulates the regeneration of periapical tissues [4]. There are different techniques and materials used for

endodontic surgery; retrograde obturation is one of the mostly performed procedures in surgical endodontic treatment [4]. Endodontic retrograde filling material is a filling placed in the apical part of a tooth root to seal that affected part of the root after surgical intervention [6]. The objective of retrograde filling is to achieve tight obturation of the apical canal which is needed to keep microorganisms and their byproducts out of the periapical region, in addition, diminishing the leakage of irritating agents in the canal's wall interface and contributing to periapical repair [5,7]. An ideal endodontic repair material must furnish an impervious seal, be dimensionally stable, radioopaque, non-resorbable, nontoxic and well tolerated by the peri-radicular tissues [8,9]. There is no technique, obturation material or sealer type that maintain the physical or biological properties [10]. Literature suggests various retrograde filling materials have been used for root repair including amalgam, zinc oxide-eugenol, intermediate restorative material (IRM), composite resins, carboxylate cements, zinc phosphate cements and glass-ionomers [11]. However, the recent advancements include Mineral Trioxide Aggregate (MTA), Biodentine and Bio-ceramic [12]. Consequently, this reviews aim was to collect all updated and available studies including imperative information concerning the best retrograde filling material among the three materials (Bioceramic, Biodentine, and MTA) following endodontic surgery.

## **Materials and Methods**

This review was reported in accordance with the PRISMA statement.

### **Focused question**

"Which is the best retrograde filling material among the three materials for endodontic surgery?"

### **Search strategy**

Systematic way was performed to look-up for relevant information through several literatures and search engines with a great concern to the main question. Such study was accomplished in December 2018 and applauded with new information's until June 2019. A web search was done through PubMed (2008 - 2018) and Google Scholar (2008 - 2018) with MesH terms and/or in various combinations ("Bioceramic", "Biodentine", "Mineral Trioxide Aggregate", "apical seal", and "retrograde filling" or "repair material").

### **Inclusion criteria**

- Native research released in the English language.
- Time framed articles released within 10 years from 2008 - 2018.
- Studies carried out on human subjects only.

### **Exclusion criteria**

- Articles that described the different of retrograde fillings excluding Bioceramic, Biodentine, and Mineral Trioxide Aggregates.
- Articles that discussed the three different of retrograde fillings by percentages and samples taken from animals.
- Review articles.

Relevant articles had been red and assessed by the introduction of the close meaning ideas by the study reviewers. Full articles were obtained for most of the titles and abstracts that met the inclusion criteria, full text was accessed. From each included article, Study design, interventions and controls, and findings were extracted. Articles used were categorized into two main groups (free and restricted). Free ones have been downloaded directly by the URLs generated from database. The restricted group has been downloaded by the institutional access of KAU library. Even though some articles weren't mach the main idea, they have been reviewed again and decided to be either relevant or irrelevant. An understanding was there between the authors in relation to suitability of the chosen articles. Even the reference was examined to identify any studies that haven't been covered by the electronic searches. A summary of this review search strategy was summarized in figure 1.

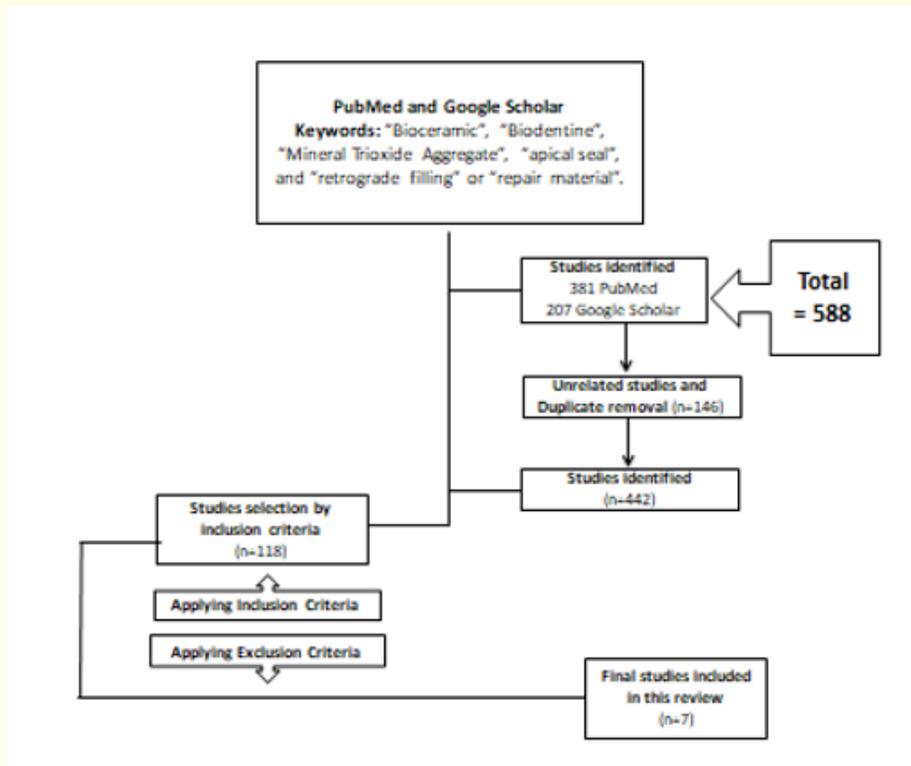


Figure 1: Flow chart of the electronic search strategy used in this systematic review.

## Results

Our exploration uncovered seven studies which met the exclusion and inclusion criteria. These studies investigated the bioactivity of Biodentine in compared with Mineral Trioxide Aggregates. All the studies included in this systematic review were four *In vitro* studies [13-16], one prospective randomized controlled study [17], one retrospective clinical study [18] and one case report [19]. In regard to the types of retrograde filling materials performed, three studies were performed with MTA and Biodentine [13-15] and two studies were done with Bioceramic and MTA [16,17]. The placement of Bioceramic alone as retrograde filling material was made in one study [18] and in the other two case reports, Biodentine was placed alone [19]. In regard to the apical sealing of these retrograde filling materials, three studies showed significant outcomes between them [13-15] and another one study found no noteworthy variance in the leakage of Bioceramic when compared with MTA [16]. In regard to success rates of healing following endodontic surgery when retrograde filling materials used, three studies [17-19] found that healing of lesion was high in case of Bioceramic used as retrograde filling material compared to MTA and Biodentine. All the included studies summarized in table 1.

## Discussion

This systematic review conducted to summarize, locate, appraise and synthesis all high quality research evidence taken from seven articles, which included original studies relevant to scientific research question. The question of this review is "Which is the best retrograde filling material among the three materials for endodontic surgery?". All included studies confirmed different retrograde filling materials

Authors/Study Design	Year	Main Results	Main Conclusion
Paula A., <i>et al.</i> Portugal, ( <i>In vitro</i> study) [13]	2019	Both investigated materials increased in the gene expression.	It seems MTA is gold standard as osteoinductive material and biodentine might be an alternative for MTA.
Zhou W., <i>et al.</i> China, (Prospective randomized controlled study) [17]	2017	Significant Outcomes of both materials included the quality of retrograde fillings and size of lesion.	BP Plus Root Repair Material (BP-RRM) is similar to MTA when used as root-end filling materials in endodontic surgery.
Shetty S., <i>et al.</i> India, ( <i>In vitro</i> study) [14]	2017	MTA Angelus illustrated least microleakage then Biodentine and MTA Plus.	MTA Angelus illustrated superior to Biodentine and MTA Plus according to the sealing ability as a retrograde filling material.
Shinbori N., <i>et al.</i> USA, (Retrospective clinical study) [18]	2015	This retrograde material not illustrated any significant effects on the result by any prognostic factors.	ES-BCRR is an appropriate retrograde filling material to be used in endodontic surgery.
Saravanapriyan S., <i>et al.</i> India, ( <i>In vitro</i> study) [15]	2014	MTA and IRM not large difference between them, but when these 2 material compared to Biodentine there are significant difference between them.	MTA and IRM superior when compared to Biodentine used as retrograde filling materials.
Gregory C., <i>et al.</i> France, (Case Report) [19]	2014	They found completely healed at 1 year.	Biodentine is a suitable retrograde filling material for endodontic surgery, applying excellent biological properties and quick clinical setting time.
Nair U., <i>et al.</i> USA, ( <i>In vitro</i> study) [16]	2011	No significant difference in leakage between them.	Bioceramic Root Repair Material (BCRR) is comparable in sealing ability to MTA when used as retrograde filling material.

**Table 1:** Summary of all included studies in this systematic review.

used following endodontic surgery. The recently published systematic review by Abusrewil SM., *et al.* at 2018 [20] illustrated the endodontic microsurgery and nonsurgical retreatment have stable results showing the Bioceramics, Super ethoxybenzoic acid (Super EBA) and IRM are shown to be successful root-end filling materials. Also, another systematic review by Alghamdi F at 2019 [21] has compared the osteogenic potential of dental repair materials. He found both NeoMTA Plus and ProRoot-MTA had osteogenic activity when used as endodontic repair material due to their biocompatibility [21]. This clearly shows differences in types of retrograde filling materials according to the conclusions reached by systematic reviews to date. When examining our included studies individually, 7 studies favored the use of three retrograde filling materials are Bioceramic, Biodentine, and MTA after the endodontic treatment. However, in spite of MTA is good physical and biological properties and hydrophilic nature; its use has permanently kept defy due to its technique sensitivity, prolonged setting time, and high cost [15]. Biodentine, which is analogous to MTA in its basic composition, but has setting time that is extremely decreased by a combination of different effects, i. particle size highly influences the setting time [22]. ii. Adding calcium chloride to the liquid component accelerates the system [23,24]. iii. Lastly, the reduction of the liquid content in the system rebates the setting time to harden within 9 - 12 minutes [23-26].

There are different studies assess the pH and calcium ion release of different retrograde filling materials. In Paula A., *et al.* study [13] at 2019; to evaluated MTA and Biodentine when used as retrograde fillings; the findings were reported Biodentine offered alkaline pH and ability to release calcium ions comparable to that of MTA as previous studies [27-29]. For Bioceramic, the high pH and released calcium ions are required for a material to activate mineralization in the process of hard tissue healing [30]. Bioceramic have a potent antimicrobial action, it kills the bacteria within two minutes of contact. This is due to its high ph, calcium hydroxide diffusion [19]. There is agreement in regard to effect of retrograde filling materials in healing of lesions, three studies concluded that there were high significant success rates of complete healed or remained healed of periapical lesions after endodontic surgery when these three retrograde filling materials used [17-19].

In the present systematic review, it concluded to most of investigated studies showed significant difference among different cements and sealants used for retrograde filling materials. In-addition, Bioceramic followed by MTA and Biodentine showed the highest sealing ability [16-18]. Furthermore, the three root-end filling materials don't possess ideal characteristics, but studies have revealed that Bioceramic, MTA, and Biodentine are superior to other retrograde filling materials.

## **Conclusion**

In this systematic review, concluded that select and placement of biocompatible retrograde filling material for management of endodontic surgery cases would great significant effect of the endodontic treatment outcome and prognosis. Bioceramic compared with MTA and Biodentine had the best retrograde filling material over all other filling materials and more investigations should be performed regarding that. Furthermore, the endodontic specialists should consider using retrograde filling materials, which have been biologically and clinically appraised and which give evidence of long term success.

## **Conflict of Interest**

None.

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