Review Article

Clinical Properties and Efficacy of MTA VS Biodentine VS GIC in Repairing Root Perforations

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Abstract

Root perforation is any condition be it pathologic or accidental exposure that leads to direct communication between pulp and periodontal as a result of reabsorption, iatrogenic, or dental caries. The study aims to establish the efficacy and clinal properties of MTA, Biodentine, and GIC in repairing root perforations. The systematic review was the method that was used and articles were selected from previous kinds of literature abiding by the inclusion and exclusion criteria to ensure that only articles with relevant information are considered for review. This systematic review utilized the Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The focused question is: which material is the most effective in repairing root perforations between MTA, Biodentine, and GIC. The findings show that biodentine was preferred more t than MTA and GIC since most of the studies roots for biodentine. Biodentine reports better clinical outcomes compared to GIC and MTA in repairing root perforations. The systematic review uncovered that most of the previous researches found biodentine to exhibit better clinical outcomes. Therefore, clinical practices can leverage this study to guarantee better clinical outcomes when dealing with root perforation repair.

Keywords: MTA, Biodentine, GIC, Root perforatioftgns

Introduction

Root perforation is any condition be it pathologic or accidental exposure that leads to direct communication between pulp cavity and periodontal tissues as a result of reabsorption, iatrogenic, or dental caries [1, 2]. Root perforation is believed to be one of the most unprecedented accidents that happen during endocrine treatment subsequently several prominent clinicians and endodontic subspecialties see this condition as challenging. Mangala and Pawar (2020, P.658) note that having a very pleasing and tasteful condition requires one to maintain functional and characteristic Dentition [3]. However, on the course of endodontic treatment, many unprecedented situations can happen such as punching of the root water divider. Wavdhane *et al*. (2020, P.4) acknowledge how difficult is the repair of perforation by a dentist [4].

As Mangala and Pawar (2020, P.658) highlight, endodontic treatment's main objective is to make sure that all microorganisms present within the root cavity/canal are cleaned and also the root trench framework is sealed viably [3]. However, endodontic punctures cause the epithelium to be multiplied, damage the periodontal accessibility, bone problems, and bacterial invasion, which can subsequently lead to an inevitable loss of teeth. Furcation punctures are believed to be the major iatrogenic challenges capable of triggering endodontic diseases [3]. Root canal treatment (RCT) is a procedure that encompasses many steps even more dependable and yet one of the most problematic procedures. It is imperative to assess root canal systems and also the presence of confluence apices, estimate distance towards root end, and check for symmetry between bilateral teeth. Therefore, it is important to fix these punctures with the most appropriate materials to achieve successful treatment.

Several materials have been introduced to treat problems related to the root aperture but despite the effort, none of the materials was shown to restore punctured furcations appropriately. The materials were namely; Glass Ionomer concrete, Zinc Phosphate concrete, Light Cure Glass Ionomer, Amalgam, Indium Foil, Cavit, and Calcium hydroxide, among others [3]. The challenges faced by these materials are they do not seal the correspondence hidden tissues and the root hole. Therefore, advanced materials were

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needed to break the current gap that exists when it comes to puncturing, including Mineral Trioxide Aggregate (MTA), Glass Ionomer Cement (GIC), and Biodentine. Alghamdi and Aljahdali (2019, P.471) and Alazrag *et al*. (2020) emphasize that the ideal perforation repair material should be characterized by biocompatibility, radiopaque, proper sealing, not absorbable, and allow for easy manipulation [1, 5]. The purpose of this systematic review is to establish the efficacy and clinal properties of MTA, Biodentine, and GIC in repairing root perforations.

Materials and Methods

This systematic review utilized the Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The focused question is: which material is the most effective in repairing root perforations between MTA, Biodentine, and GIC?

Search Strategy

The search was performed to find quality articles that can be used to provide quality information about the repairing of root perforations. The information was searched in different databases such as Google Scholar, ProQuest, and PubMed. Various keywords were used during the search. They include "root perforation," "biodentine," repair material," "Glass Ionomer Cement," and "Mineral Trioxide Aggregate."

Inclusion Criteria

The inclusion criteria entailed various conditions that the selected articles were supposed to meet. First, all studies included were in the English language, with a timeframe of between 2019 and 2021. Second, studies that were carried out on animals and human beings were considered for review. Third, before any article could be selected, it must address either biodentine, Glass Ionomer Cement, or Mineral Trioxide Aggregate, or all of them. Finally, only full-text articles were eligible to be considered for review.

Exclusion Criteria

The first exclusion criteria entailed articles that focused on other repair materials without mentioning biodentine, Glass Ionomer Cement, or Mineral Trioxide Aggregate. The second element of exclusion is studies that concentrated on the different clinical applications of repair materials without a clear focus on root perforation. The strategy was to ensure that the selected articles are relevant and provide the needed information to establish facts related to MTA, GIC, and biodentine. Finally, other articles that were not considered include commentary articles, surveillance reports, and perspectives.

All studies selected were evaluated to determine whether they meet the inclusion criteria. Some articles were assessed by reading the abstract and establishing where the summary provided captures the keywords of the topic. Other articles were investigated in-depth since their topics were not descriptive enough to reveal all the details discussed in those materials. Furthermore, the references used in the studies were examined to establish whether they are from reputable databases and written by acknowledged professionals. Most importantly, all articles selected for review were peer-reviewed. This move was meant to guarantee that only reputable and reliable data can be used to accomplish the objectives of this systematic review. The relevance of each article was examined and studies that satisfied the set criteria for inclusion were scheduled for review. After screening, a total of 20 articles were picked from a pool of 150 studies. The PRISMA flowchart in **Figure 1** below displays the eligibility criteria for the exclusion and inclusion of articles based on relevance.

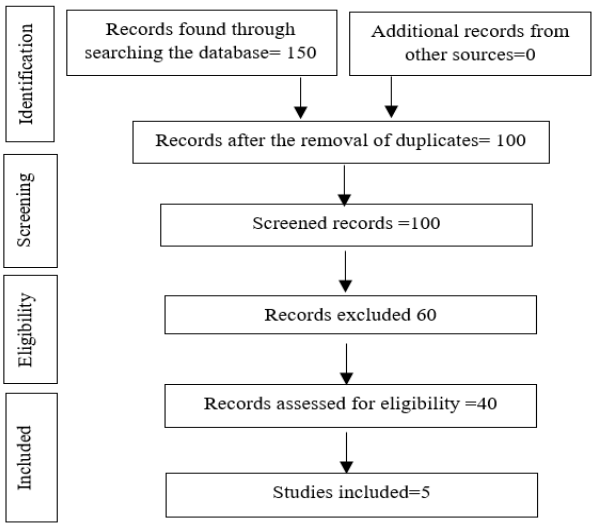

Figure 1. Eligibility criteria for inclusion and exclusion based on PRISMA guidelines

Bias Risk Assessment

A bias risk assessment was conducted on all the selected articles utilizing the Cochrane risk of a bias assessment tool. This form of bias assessment is based on five domains that include reporting, attrition, performance, selection, and other bias. Therefore, the assessment of bias is done as a verdict of high, low, or unclear. **Table 1** below shows the Cochrane risk of bias assessment. **Table 2** shows the overall risk of bias judgment.

Table 1. Cochrane Risk of bias assessment

Domain	Description	High risk of bias	Low risk of bias	Unclear risk of bias	Reviewer assessment

Selection bias ***Random sequence generation***	Describes the methods utilized to create an allocation sequence to establish whether comparable groups should be produced.	Insufficient creation of random sequence implies selection bias	Comparable groups should be produced for random sequence generation.	Not described in enough details	Judgment
Selection bias **Allocation concealment**	Methods used to conceal allocation described	Inadequate concealment implies selection bias	A possibility of failing to foresee intervention allocations	Not enough details	Judgment
Reporting bias **Selective reporting**	Should state the examination of selective outcome reporting	Selective outcome reporting leads to reporting bias	No detection of reporting bias linked to selective outcomes	Not enough details	Judgment
Other bias	Any other issues related to bias not covered	Bias concerns due to issues not addressed in other places	No detection of other bias	Insufficient information to reveal other bias	Judgment

Table 2. The overall risk of bias judgment

Study	Risk of bias judgment	Justification
[1]	Low risk of bias	No detection of any form of bias for the study.
[3]	Low risk of bias	No form of bias can be detected in the article.
[6]	Unclear risk of bias	Not enough details to reveal selection, reporting, and other biases.
[7]	Low risk of bias	Selection and reporting bias was not spotted in the study.
[8]	Unclear risk of bias	The study does not describe how the different forms of bias have been addressed.

Results and Discussion

The exploration conducted resulted in twenty studies that met the inclusion and exclusion criteria. In total, 150 articles matched the search approach based on the picked keywords. However, after the removal of duplicate records 100 articles were selected for screening, out of which 60 studies were excluded. At this point, 40 articles were eligible for assessment since they were full articles. Out of the 40 studies, 5 qualified to be included in the qualitative synthesis. Specifically, these studies focused on MTA, GIC, and biodentine, and how they are used in root perforation. The studies collected articles include In-vivo studies, In-vitro studies, retrospective clinical studies, and randomized controlled trials (RTC). The majority of the articles addressed more than one element of interest. For instance, some articles compare biodentine and GIC, others compared MTA and GIC, while others compared biodentine and MTA. Other studies addressed either MTA, GIC, or biodentine, while other articles compared either GIC, MTA, or biodentine with other materials used for root perforation. **Table 3** below shows a summary of the studies **(Table 3)**.

Table 3. A summary of the studies

Author and year	Inclusion criteria	Findings
[1]	Addressed MTA and Biodentine	There is no unanimity in regards to the most suitable repair material for root perforation.
[3]	Addressed Biodentine, MTA, and GIC	Biodentine is superior to MTA in perforation sealing even though the difference is insignificant statistically.
[6]	Addressed Biodentine and MTA.	Biodentine is better than MTA for root-end filling due to the least margin gap at the edge.
[7]	Focused on MTA and Biodentine, among other root perforation filling materials	Based on the leakage mean, MTA samples showed better results with a reduction in the value of leakage mean after a month compared to Biodentine.
[8]	Addressed Biodentine, GIC, and Pro-Root MTA	Biodentine showed better results compared to Pro-Root MTA and resin-modified GIC concerning sealing ability.

Based on the synthesized studies, various facts emerged with the bottom line being that the physical and chemical properties of the materials used affect the root perforation prognosis. The purpose of this systematic review was to gather data about the different materials leveraged for root perforation repair. The systematic review summarized, appraised, and synthesized high-quality research evidence from 20 articles to establish the most appropriate material that can be used for root perforation therapy. The general

outcomes show that the reviewed studies confirmed diverse repair materials utilized for root perforation.

A study by Alghamdi and Aljahdali (2019, P.474) established that there is no unanimity in regards to the most suitable material that can be utilized for the treatment of root perforation [1]. Alghamdi and Aljahdali (2019, P.474) claim that some of the studies reviewed in their research revealed that the assessment of the sealing capacity of biodentine and MTA led to the declaration that no considerable differences were noticed between the two materials, with biodentine being preferred as an alternative to MTA [1]. Mangala and Pawar (2020, P.660) concluded that light-cured GIC allows more amount of dye leakage as opposed to biodentine and MTA [3]. Bansal *et al*. (2019, P.10) found out that biodentine was superior to MTA Plus and ProRoot MTA after it exhibited a reduced hole at the edge of the root-end and dentin filling materials [6]. Also, Nabeel *et al*. (2019, P.20) rooted for biodentine in peri-radicular surgeries instead of ProRoot MTA despite the latter exhibiting greater sealing ability [7].

On the other hand, Mohan *et al*. (2021, P.82) assert that MTA provides a more efficient root perforation restoration compared to other perforation repair materials [8]. Grover *et al*. (2020), Kakani *et al*. (2020), Tang *et al*. (2019) hold that biodentine has a better sealing ability compared to MTA [9-11]. Francis *et al*. (2019, P.34) claim that for large furcal perforations, the sealing ability of biodentine and MTA-Angelus shows no significant difference [12]. However, in support of MTA, Jian *et al*. (2019) affirm that the repair efficiency of MTA has a positive correlation with perforation diameters, repair materials, and ages of patients [13]. Bossù *et al*. (2020) concluded that MTA is better than bioentine in the primary teeth' pulpotomy [14]. Saad (2020) note that MTA-based sealers are part of the broad category of calcium silicate-based root canal sealers [15].

On their part, Bjørndal *et al*. (2019) assert that biodentine can overcome some of the concerns of discoloration that characterizes MTA [16]. Arandi and Thabet (2021) support biodentine by claiming that it has a good clinical efficacy when it comes to pulp capping [17]. According to Alzahrani and Alghamdi (2021), MTA contributed to tissue healing without pain due to palpation and percussion [18]. Aldayri *et al*. (2019, P.10) roots for MTA in the sense that it can be utilized in "furcal perforated-pulpotomized primary molars" as a repair material [19]. Additionally, MTA can induce cementum tissue formation during its perforation repair [20].

Conclusion

Based on the reviewed studies, it can be depicted that biodentine is the most favored material for root perforation repair compared to MTA and GIC. The systematic review uncovered that most of the previous research found biodentine to exhibit better clinical outcomes, hence, emerging as a superior one among the three. Therefore, clinical practices can leverage this study to guarantee better clinical outcomes when dealing with root perforation repair.

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