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Provisional restorations: a literature review

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Abstract

Introduction: Minimally invasive dentistry advocates the use of dental materials with adhesive properties; aims to provide means for remineralization of dental tissue damaged by caries and to prevent the progression of initial caries in order to promote maintenance and longevity of dental elements in the mouth. Glass ionomer cement is a prominent material in the current dentistry, because it added favorable physical and biological properties, which were not obtained with other materials. Thus, one of the main objectives of restorative dentistry is the preservation of healthy dental tissues as well as the restoration of lost tissue seeking, through the use of suitable materials and well-conducted techniques, to avoid recurrences or even the appearance of new caries. **Objective:** It was to provide a literature review on the main findings of the use of glass ionomer cement in dental restorations. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was conducted from July to August 2025 in the Web of Science, Scopus, Embase, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** According to the GRADE instrument, most studies presented homogeneity in their results, with X^2=88.5%>50%. A total of 126 articles were found and submitted to eligibility analysis, with 26 final studies selected to compose the results of this systematic review. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 20 studies with a high risk of bias and 29 studies that did not meet GRADE and AMSTAR-2. It was concluded that the objectives of restorative treatment in deciduous teeth with glass ionomer cements are to repair or limit damage caused by caries disease, protect and preserve dental structures, restore proper function, restore aesthetics (when appropriate), and provide a condition that facilitates the maintenance of good oral hygiene. It is imperative that the dental surgeon remembers that pulp vitality should be maintained whenever possible.

Keywords: Minimally invasive dentistry. Glass ionomer cement. Restorative dentistry. Provisional restorations.

Introduction

The minimally invasive dentistry recommends the use of dental materials with adhesive properties; it aims to provide means for remineralization of dental caries lesions by caries and aims to prevent the progression of initial caries in order to promote maintenance and longevity of dental elements in the mouth [1,2]. Adhesive materials, such as glass ionomer cement (GIC), which is widely used in techniques of minimal intervention, such as atraumatic restorative treatment (ART), provide advantages in terms of dental tissue removal, dental tissue economy, and reduction of preparation cavitations, involving healthy dental structures, which are conventionally performed [2,3].

In ART, the restorative material GIC acts on the remineralization of the tooth, promoting diffusion of fluoride, calcium, and phosphate ions, which occurs concurrently with the patients' satisfactory oral hygiene, which should be oriented and educated enough to that [4]. The GIC, therefore, deriving from its beneficial

characteristics that meet current trends, is closely related to the precepts of preventive and minimally invasive dentistry and the new recommended conservative techniques. It is desired to maintain healthy tooth structure, and to recover if necessary is lost dental tissue. Restorative materials and techniques are used in order to avoid carious recurrences and the appearance of new lesions. In this context, the VSD has a prominent role, resulting from its intrinsic therapeutic character [4,5].

Glass ionomer cement is a prominent material in current dentistry, because it added favorable physical and biological properties, which were not obtained with other materials [6]. Thus, one of the main objectives of restorative dentistry is the preservation of healthy dental tissues as well as the restoration of lost tissue seeking, through the use of suitable materials and well-conducted techniques, to avoid recurrences or even the appearance of new caries. Among these materials, the most important are glass ionomer cements [6,7].

The main purpose of the development of the GIC was to create a restorative material that would replace the silicate cement. This material can be used in temporary restorations in expectant treatments, replacing the zinc oxide and eugenol cement or in processes of adjustment of the buccal environment until the patient's oral health is restored [8].

Scientific evidence and literature support the use of GIC, as long as properly applied, as effective for both deciduous and permanent teeth, improving retention, minimizing infiltration, and reducing sensitivity. As evidence of this, the analysis revealed the formation of new compounds or molecular rearrangements resulting from the chemical interactions between the GIC and dentin. In addition, this study provides an effective method to evaluate the dynamics of the GICs configuration mechanism [1].

The present work aimed to make a literature review about the main findings of the importance of the use of glass ionomer cement in dental restorations.

Methods

Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed at: 08/18/2025. The AMSTAR 2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. Accessed at: 08/18/2025.

Search Strategy and Search Sources

The literature search process was carried out from July to August 2025 and developed based on Web of Science, Embase, Scopus, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The following descriptors were used in health sciences (DeCS/MeSH terms): *"Minimally invasive dentistry. Glass ionomer cement. Restorative dentistry. Provisional restorations"*, and the Boolean "and" was used between the MeSH terms and "or" between the historical findings.

Study Quality and Risk of Bias

Quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. Low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's test (d).

Summary of Findings

A total of 126 articles were found and submitted to eligibility analysis, with 26 final studies selected to compose the results of this systematic review. The listed studies were of medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analysis, consensus, randomized clinical, prospective, and observational. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies presented homogeneity in their results, with X^2=88.5%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 20 studies with a high risk of bias and 29 studies that did not meet GRADE and AMSTAR-2.

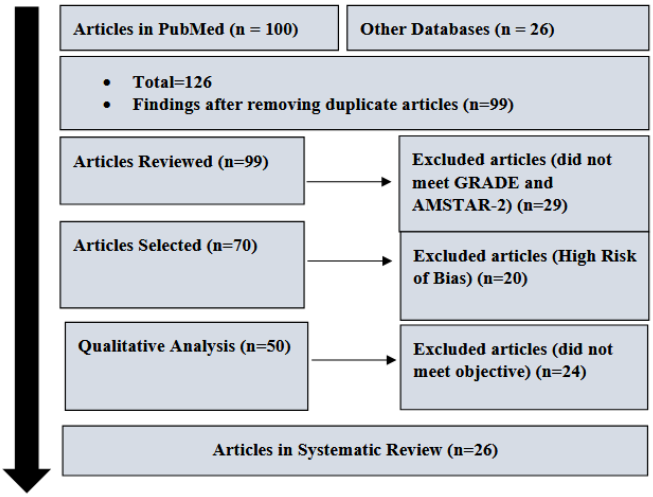

Figure 1. Flowchart showing the article selection process. Source: Own Authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). Precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both among studies with small sample sizes (lower precision) that are shown at the base of the graph and in studies with large sample sizes that are presented at the top.

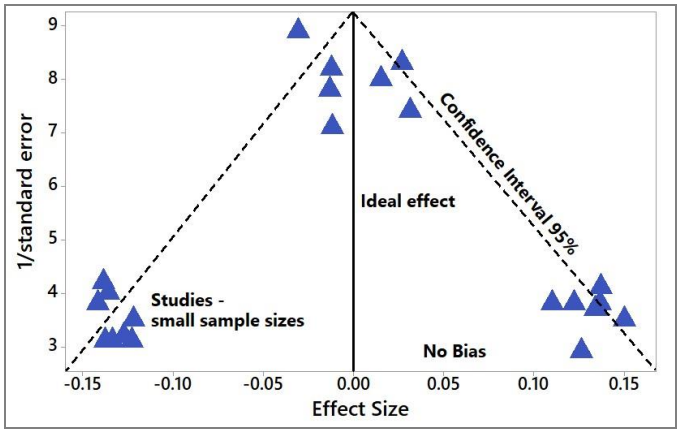

Figure 2. The symmetrical funnel plot suggests no risk of bias among the studies with small sample sizes that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (n=26 studies). Source: Own Authorship.

Main Clinical Results

Glass Ionomer Cements (GIC) have been used as materials for restoration, found as forrador, restorer, and cementer [1-3]. Glass ionomer cements result from an acid-base reaction between glass particles and a water-soluble polymer. The first cements were difficult to handle, exhibited low wear resistance, and were friable [3].

Advancements in the formulation resulted in the improvement of such properties, including the development of resin-modified glass ionomer cements. These products have superior handling characteristics, reduced prey time, increased compressive strength, and wear resistance [3,4]. GIC have several properties that favor its use in children, as well as chemical bonding to enamel and dentin, thermometer expansion similar to tooth structure, biocompatibility, recharging and release of fluorine ions, and lower sensitivity to moisture when compared to composites [5-7].

Glass ionomer cements are hydrophilic and tolerate a moist but not wet environment, while composites and adhesives are negatively affected by water. Due to their ability to adhere, seal, and protect, ionomeric cements are often used as materials for dentin replacement [8,9]. These cements present a coefficient of thermal expansion similar to that of dentine. Resin-modified glass ionomer cements have higher wear resistance compared to conventional ionomeric cements and are very suitable restorative materials for primary teeth [10-13].

The sandwich technique employing ionomeric cements and resins was developed considering the best properties of each material [14,15]. An ionomeric cement is used to reproduce the dentin due to its sealing and adhesion ability, which is covered by resin due to the superior wear resistance and esthetics provided by this material [16]. Another possibility is to cover the ionomeric cement with composite resin when it presents excessive wear over the years [17].

In this case, the GIC can only be lowered and serve as a basis for composite resin restoration. Thus, ionomeric cements may be recommended for cementation, base and cavity formation, occlusal and occlusal-proximal restorations in deciduous and permanent molars, restorations on anterior teeth (free and / or contact smooth surfaces) in deciduous and permanent teeth, adhesive restorations in deciduous and permanent teeth, and minimally traumatic restorative treatment [18-20].

As the GIC has the capacity to absorb and store fluoride, it was expected that with the use of fluoride dentifrice, there would be an increase in the anticariogenic effect of this cement, leading to a slow release of it and inhibition of caries formation [21]. However, the study showed that conventional GIC has the same cariostatic effect both with the use of non-fluoridated and fluoridated dentifrices and therefore is not influenced by the type of toothpaste [21].

From a study made to determine the inhibitory effect of restorative materials such as GIC, amalgam, and photopolymerizable composite resin in the formation of secondary caries, it can be affirmed, measuring each lesion formed, that the VSD presents a smaller area of carious lesion and more number of areas with caries inhibition due to their large release of fluoride [22-24]. Around amalgam restorations, lesions of intermediate size were observed, due to the fact that some of their constituents (Ag, Cu, Zn, and ions) exert a cariostatic role through their release. The highest index of lesions was observed in the composite resins, probably due to a lack of fluoride release and antibacterial properties. Even those that contain fluoride do not have anticariogenic action and inhibitory power of caries, because they have an organic constitution and because the resinous matrix prevents the contact

of fluoride with water, decreasing its release [25].

The anticariogenic power of the GIC is described by Mota et al. (2008) [26], who, when investigating the number of Streptococcus mutans in saliva and plaques adjacent to orthodontic brackets, have shown that the percentage of these microorganisms is lower in places adjacent to this cement than in those adjacent to the composite resin. However, they point out that the anticariogenic activity occurs in the initial phase and not in the long term. Despite its undisputed benefit, the release of fluoride presented by the GIC causes disadvantages to patients susceptible to infections caused by fungi such as Candida albicans spp. Although this microorganism is part of the human oral microbiota, in some situations it may act as an opportunistic microorganism, especially in patients with total prosthesis, immunosuppressed patients, and people receiving antibiotics [25].

The GIC does not present great activity in the elimination of Candida albicans spp. probably due to the great concentration of fluoride released by this material, being more prudent the use Zinc Oxide Cement and Eugenol [13]. Therefore, GIC is not the material of choice in patients susceptible to superinfections caused by this microorganism. Another possible disadvantage in the use of GIC when compared to other restorative materials, and that is not totally coherent among similar studies, is the marginal microleakage, which is a clinical problem that seeks a solution through the choice of the ideal material [13].

Marginal microleakage is defined as the diffusion of liquids, bacteria, molecules, and ions between the cavity wall and the restorative material. Hoshi et al. (2005) [23], evaluating restorations of amalgam, GIC, cavity varnish, and dentin adhesive, concluded that none of the study materials was able to eliminate marginal microleakage, but VSD proved to be more effective when compared to other materials. Failure in 2005 describes that although the GIC fills almost completely the cracks, it is not able to prevent the penetration of dyes; however, it promotes better results when compared to sealants and resins. Gjorgievska et al. (2008) [22], contrary to the previous studies, demonstrated that the resin and the polyacid-modified composites showed to have a better marginal adaptation than the GIC, although they developed fissures of enamel.

The GIC showed inferior durability and marginal quality, but did not present enamel microcracks. It has been shown that the marginal fit in deciduous teeth is slightly lower than that of immature permanent teeth, especially when resin-based materials are used. On the other hand, there is no difference between these two types of teeth when conventional GIC is used. Ferreira et al. (2006) [18] reported that, although VSD does not prevent microleakage at the tooth interface and restoration, the material performs well in clinical situations because of its fluoride release capacity that may delay or prevent the development of secondary caries, which represent the true clinical threat of microleakage.

In dentistry, it is recommended the development of restorative materials that have incorporated some favorable characteristics for clinical use, such as: fast handling and application; reproduction of the anatomical and aesthetic characteristics of the teeth; Satisfactory marginal sealing after insertion in the cavity preparation as restorative material and chemical and mechanical resistance to the chemical manifestations of the buccal environment when inserted into the mouth [1,2]. In this context, GIC has been constantly studied, which allowed the inclusion of some new modified materials in its composition and with improved characteristics such as: increased compressive strength and wear; aesthetic improvement; uncomplicated handling and increased surface hardness [2].

It is important that before using the GIC, the dental surgeon perform a chemical and structural analysis of the material, in order to become better acquainted with the physico-chemical properties and with the chemical elements and the morphological structure of the cement. Different properties can be found by analyzing the composition of the VSD and how the surface of the material will react with the surrounding tissues in the buccal medium. The surface of the GIC offers data about how its properties interact with biological systems, which may define biocompatibility or cytotoxicity criteria when used [4-5].

Conclusion

It was concluded that the objectives of restorative treatment in deciduous teeth with glass ionomer cements are to repair or limit damage caused by caries disease, protect and preserve dental structures, restore proper function, restore aesthetics (when appropriate), and provide a condition that facilitates the maintenance of good oral hygiene. It is imperative that the dental surgeon remembers that pulp vitality should be maintained whenever possible.

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