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Interdisciplinary Applications of Glass Ionomer Cement in Dentistry, Dental Technology, Laboratory Sciences, and Dental Radiology

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Abstract

Background: Glass ionomer cement (GIC) is a widely used dental material known for its chemical adhesion to tooth structure, fluoride release, and biological compatibility, making it valuable across multiple dental disciplines. Since its development in the early 1970s, continuous modifications have expanded its clinical and interdisciplinary applications.

Aim: This article aims to review the composition, properties, clinical indications, limitations, and interdisciplinary relevance of glass ionomer cement in dentistry, dental laboratories, and allied healthcare practice.

Methods: A narrative review approach was employed, synthesizing existing scientific literature and clinical evidence related to the chemistry, setting mechanism, manipulation techniques, and clinical performance of conventional and modified glass ionomer cements.

Results: Glass ionomer cement demonstrates reliable chemical bonding to enamel and dentin, sustained fluoride release with anticariogenic effects, and favorable biological responses. Advancements such as resin-modified, metal-reinforced, and high-viscosity formulations have improved handling characteristics, early strength, and moisture tolerance. However, limitations remain, including lower fracture resistance, reduced abrasion resistance, and esthetic constraints in high-stress or highly visible areas.

Conclusion: Glass ionomer cement remains an essential restorative and preventive material when appropriately selected according to clinical demands. Its dentin-like properties, fluoride-mediated protection, and compatibility with interdisciplinary care continue to support its significant role in modern dental practice.

Keywords: Glass ionomer cement, fluoride release, restorative dentistry, dental materials, interdisciplinary dental care.

Introduction

Glass ionomer cement (GIC) is recognized as a self-adhesive dental restorative material with distinctive chemical and biological characteristics that support its widespread clinical application [1]. It is formed through an acid–base reaction between a fluoro-aluminosilicate glass powder and an aqueous solution of polyacrylic acid, resulting in a material capable of chemical bonding to enamel and dentin. This inherent adhesion reduces the need for extensive tooth preparation and contributes to the preservation of tooth structure. In addition, GIC demonstrates sustained fluoride release, which plays a significant role in inhibiting demineralization and enhancing remineralization, thereby providing a marked anti-cariogenic effect. These properties make it particularly valuable in both adult and pediatric dental practice. The development of glass ionomer cement dates back to its initial description by Wilson and Kent in 1972, after which continuous modifications were introduced to enhance its mechanical strength, handling characteristics, and clinical performance. Over time, these improvements expanded the scope of GIC applications across multiple dental disciplines. Clinically, GIC is employed for the cementation of fixed dental prostheses, orthodontic bands, and brackets, as well as for the restoration of carious and noncarious

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cervical lesions. It is also widely used as a liner or base beneath restorations, as a core build-up material, and as a pit and fissure sealant. Furthermore, its favorable adhesion and fluoride-releasing capacity have made it a cornerstone material in atraumatic restorative treatment protocols, particularly in community and preventive dentistry settings [2].

Function and Composition

Glass ionomer cement (GIC) functions as a restorative and luting material that combines chemical adhesion to dental hard tissues with fluoride release, making it valuable for both preventive and restorative dentistry. Its ability to bond directly to enamel and dentin without the need for an intermediate bonding agent supports conservative cavity designs and preservation of tooth structure. In addition, the sustained release of fluoride ions contributes to caries inhibition and promotes remineralization of adjacent tooth surfaces, enhancing the long-term clinical performance of restorations. From a compositional perspective, glass ionomer cement is most commonly supplied as a powder–liquid system that requires manual mixing. The powder consists primarily of fluoro-aluminosilicate glass, which serves as the reactive filler and the source of fluoride ions. The liquid component is an aqueous solution of polyacrylic acid that may be copolymerized with other organic acids such as maleic, tartaric, or itaconic acid to control viscosity and improve handling properties. These modifications stabilize the liquid and regulate the setting characteristics of the cement. The liquid also exhibits thixotropic behavior, meaning its viscosity decreases when agitated or warmed, facilitating dispensing and manipulation. In addition to the conventional powder–liquid form, GIC is available in encapsulated systems, twin-syringe formats, and water-settable versions in which freeze-dried polyacrylic acid is incorporated into the powder, requiring only the addition of water at the time of use [3][4].

Manipulation of glass ionomer cement requires careful adherence to recommended techniques to achieve optimal physical and chemical properties. Mixing is traditionally performed using an agate spatula rather than a stainless steel instrument, as metallic spatulas can be abraded by the glass particles, leading to contamination of the cement. The manufacturer's recommended powder-to-liquid ratio must be followed closely, as deviations can compromise strength and adhesion. Typically, the powder is divided into two equal portions, and the liquid is dispensed immediately before mixing to minimize viscosity changes caused by water evaporation. The first portion of powder is incorporated into the liquid using a controlled folding motion for approximately fifteen seconds, followed by the second increment to adjust the final consistency. A properly mixed cement exhibits a glossy surface, which reflects the availability of free carboxyl groups necessary for chemical bonding to the tooth structure. In contrast, a dull or opaque appearance indicates premature setting or improper mixing and should prompt disposal of the material. Encapsulated glass ionomer cement systems offer a standardized alternative to hand mixing. These capsules are activated and mixed using an automatic triturator, producing a homogenous paste that can be dispensed directly into the prepared cavity. This approach reduces operator variability and improves consistency, particularly in clinical settings where time and precision are critical [4].

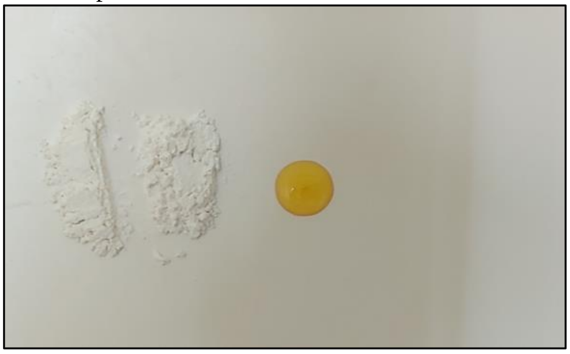

Fig. 1: Mixing Glass Ionomer Cement.

Preparation of the tooth is an essential step in ensuring effective bonding and longevity of the restoration. Prior to placement, the tooth surface should be cleaned with a pumice slurry applied using a prophylaxis cup to remove plaque, debris, and surface contaminants. After thorough rinsing and gentle drying, the tooth is conditioned with a mild solution of polyacrylic acid, typically at a concentration of ten percent for approximately ten seconds. This conditioning step removes the smear layer and increases the surface energy and wettability of enamel and dentin, thereby enhancing chemical adhesion between the cement and the tooth [4]. Following conditioning, the cavity should be rinsed and lightly dried without desiccation. The mixed glass ionomer cement is then transferred to the cavity using a suitable cement carrier and adapted with a condenser to ensure intimate contact with the cavity walls. Excessive manipulation should be avoided, as the material can adhere to instruments and compromise marginal adaptation. During the initial setting phase, the restoration should be protected from moisture contamination and dehydration. A matrix band may be used to maintain contour and isolation, and after the initial set, the surface should be coated with varnish, cocoa butter, or petroleum jelly. This protection is critical because glass ionomer cement is highly sensitive to moisture imbalance during the first twenty-four hours. Finishing procedures initially involve removing gross excess material with sharp hand instruments, while definitive finishing and polishing are best delayed for at least twenty-four hours to allow sufficient maturation of the cement. The setting mechanism of glass ionomer cement is based on a complex acid–base reaction that occurs in several stages. Immediately after mixing, the polyacrylic acid attacks the surface of the glass particles, leading to dissolution and release of ions such as calcium, sodium, aluminum, fluoride, and silicate species into the aqueous medium. During the initial setting phase, calcium ions rapidly cross-link the polyacrylic acid chains, forming a three-dimensional network that provides early rigidity, although the material remains relatively weak and susceptible to damage. As the reaction progresses over the next twenty-four hours, aluminum ions, which migrate more slowly, replace calcium ions in the cross-linked structure, resulting in a denser and stronger matrix. Concurrently, silicate ions contribute to the formation of a silica gel around the unreacted glass cores. This gradual transformation leads to increased mechanical strength and durability of the set cement. The final stage, known as maturation, involves ongoing hydration of the calcium- and aluminum-cross-linked polyacrylate chains, further stabilizing the structure over time [5][6].

Water plays a fundamental role throughout the setting and maturation of glass ionomer cement. As a water-based material, GIC contains approximately eleven to twenty-four percent water in its set state. In the early stages, water serves as the reaction medium that allows ion transport and acid–base interactions to occur. In later stages, it facilitates the slow hydration of the cross-linked matrix, which is essential for full maturation and optimal mechanical properties. However, the cement is highly vulnerable to both water loss and water uptake during the initial setting period. Rapid evaporation can lead to surface cracking and reduced strength, while excessive moisture contamination can dissolve the developing matrix and cause leaching of calcium ions, resulting in a weak and opaque restoration [7]. For this reason, immediate surface protection with varnish or similar coatings is essential to maintain the integrity of the material and ensure successful clinical outcomes.

Indications

Glass ionomer cement has a wide range of clinical indications that stem from its favorable handling characteristics, chemical adhesion to tooth structure, and sustained fluoride release. As a restorative material, it is extensively used in pediatric dentistry due to its ease of placement, tolerance to minor moisture contamination, and ability to achieve satisfactory marginal adaptation. These properties make it particularly suitable for children who may have limited cooperation during dental procedures. In permanent dentition, glass ionomer cement is indicated for restorations in areas subjected to low occlusal stress, such as Class III and Class V cavities, cervical lesions, and noncarious cervical defects. Its continuous fluoride release and recharge capability render it especially valuable in patients with a high caries risk, where prevention of secondary caries is a primary clinical objective. In addition to its restorative role, glass ionomer cement is widely employed as a luting agent. It is used for the cementation of indirect restorations, including full metal and metal-ceramic crowns, as well as posts, cores, orthodontic bands, and brackets [4][8]. The chemical bonding of GIC to enamel and dentin, combined with its adequate compressive strength and fluoride release, contributes to reduced microleakage and enhanced longevity of cemented restorations, particularly in situations where moisture control is challenging. Glass ionomer cement also plays an important role in pulp protection. It is commonly applied as a liner or base beneath metallic and composite restorations, often within the framework of the sandwich technique [9]. In this context, GIC acts as a protective barrier, providing thermal insulation, chemical bonding to dentin, and fluoride-mediated anticariogenic benefits, while supporting overlying restorative materials.

Another clinical indication of glass ionomer cement is its use as a pit and fissure sealant. Although GIC-based sealants generally demonstrate lower retention rates compared to resin-based sealants, they are indicated as temporary sealants, particularly in newly erupted permanent teeth where moisture control is difficult. Despite reduced retention, their caries-preventive effect is considered comparable to that of resin-based fissure sealants due to sustained fluoride release [10]. Glass ionomer cement is also the material of choice in atraumatic restorative technique procedures. This minimally invasive approach relies on hand instruments for caries removal without local anesthesia, followed by restoration with an adhesive material such as GIC. ART is especially valuable in settings with limited dental infrastructure or restricted access to conventional dental care, underscoring the versatility and public health relevance of glass ionomer cement [11].

Issues of Concern

Glass ionomer cement exhibits a distinctive mechanism of adhesion that differentiates it from many other restorative dental materials. Its bonding to tooth structure is fundamentally chemical and ionic in nature, allowing direct interaction with both enamel and dentin. The affinity of glass ionomer cement for enamel is consistently greater than that for dentin, a difference that can be attributed to the substantially higher inorganic content of enamel. The bonding process is governed by a chelation reaction in which the carboxyl groups of the polyacrylic acid component interact with calcium ions present in the hydroxyapatite crystals of the tooth. This interaction results in the formation of a stable ionic bond at the tooth–restoration interface, eliminating the need for separate bonding agents and contributing to reduced microleakage at restoration margins. Another defining characteristic of glass ionomer cement is its capacity to release fluoride over an extended period. During manufacture, a variety of fluoride-containing compounds such as calcium fluoride, strontium fluoride, lanthanum fluoride, sodium aluminum fluoride, and aluminum fluoride are incorporated into the glass powder, initially to function as fluxes. Subsequent investigations revealed that these compounds also impart antibacterial properties to the cement. In the fully set material, fluoride ions do not form an integral component of the cement matrix but remain loosely bound, allowing their gradual diffusion into the surrounding oral environment. This fluoride release occurs through diffusion into saliva and plaque fluid, creating a localized reservoir of fluoride ions adjacent to the tooth surface. The process of fluoride release from glass ionomer cement has been explained through two complementary mechanisms [12]. The first involves a rapid, short-term release of fluoride ions from the superficial layers of the cement immediately after placement, which is often referred to as the initial burst effect. The second mechanism is characterized by a slower, sustained diffusion of fluoride ions from the bulk of the cement matrix over time. This prolonged release is clinically significant, as it supports ongoing remineralization and inhibits demineralization at the restoration margins. The structure and composition of the cement matrix play a central role in determining the extent and duration of fluoride release [12].

Both intrinsic and extrinsic factors influence the fluoride-releasing behavior of glass ionomer cement. Intrinsic factors include the chemical composition of the matrix, the nature of the setting reaction, and the total fluoride content of the glass powder. Extrinsic factors encompass environmental conditions such as salivary pH, plaque accumulation, pellicle formation, and clinical variables including the powder-to-liquid ratio, mixing technique, setting and curing time, and the extent of exposed surface area. Surface treatments also exert a measurable effect, as the application of adhesive systems or surface-protective coatings has been shown to reduce fluoride release by approximately 1.4- to 4-fold. Notably, routine oral hygiene practices such as tooth brushing and bleaching procedures do not appear to significantly alter fluoride release patterns [13]. The sustained liberation of fluoride ions underpins the well-documented anticariogenic potential of glass ionomer cement. Fluoride exerts its protective effect through several biological pathways, including the inhibition of enamel demineralization, enhancement of remineralization, and increased resistance of enamel to acid dissolution via the conversion of hydroxyapatite to fluorapatite. At the microbial level, fluoride interferes with bacterial metabolism by inhibiting the enolase enzyme, thereby reducing acid production and bacterial proliferation. Continuous fluoride availability at the tooth–restoration interface is particularly effective in preventing secondary caries, especially in marginal gaps where plaque accumulation is likely. This anticariogenic property is a major reason glass ionomer cement is frequently selected for patients exhibiting high caries activity or compromised oral hygiene.

From a biological perspective, glass ionomer cement is regarded as both biocompatible and bioactive. Although the pH of freshly mixed cement is initially low, ranging from approximately 0.9 to 1.6, clinical and histological studies demonstrate that pulpal responses are generally mild [5]. This favorable tissue response is explained by the rapid neutralization of acidity within the first 20 minutes after placement, as well as by the high molecular weight of polyacrylic acid, which restricts its penetration into dentinal tubules. Consequently, when the remaining dentinal thickness exceeds 1 mm, the use of additional pulpal protection is typically unnecessary. These properties support the safe use of glass ionomer cement in deep cavities under appropriate clinical conditions. The mechanical behavior of glass ionomer cement reflects a balance between strength and resilience. Its compressive strength is comparable to that of zinc phosphate cement, while its tensile strength is marginally higher. Among the various formulations, Type I glass ionomer cement demonstrates lower compressive strength than Type II variants, reflecting differences in intended clinical applications. The modulus of elasticity of glass ionomer cement is relatively low and closely approximates that of dentin, making it less rigid than zinc phosphate cement [8]. This similarity in elastic behavior contributes to its designation as a “man-made dentin,” as it allows the material to flex in a manner that is compatible with natural tooth structure. The powder-to-liquid ratio plays a decisive role in determining the mechanical integrity of the set cement. Increasing the powder content enhances consistency, accelerates the setting reaction, and improves overall strength, but only within an optimal range. Beyond a critical threshold, excessive powder compromises the continuity of the cement matrix, reducing its capacity to bind components effectively and resulting in inferior mechanical properties. Strict adherence to manufacturer-recommended proportions is therefore essential. The introduction of pre-proportioned, self-contained capsules has helped minimize operator-related variability and improved the consistency of clinical outcomes [14].

In terms of physical properties, glass ionomer cement demonstrates favorable thermal compatibility with dental hard tissues. Its coefficient of thermal expansion closely resembles that of enamel and dentin, reducing stress at the tooth–restoration interface during temperature fluctuations. Additionally, its thermal diffusivity is similar to dentin, providing effective insulation to the pulp.

However, the material exhibits greater solubility in water compared to zinc phosphate and zinc polycarboxylate cements [14]. Although glass ionomer cement is tooth colored, its opacity and limited translucency restrict its use in highly esthetic anterior restorations. The clinical advantages of glass ionomer cement include its inherent chemical adhesion to tooth structure, fluoride-mediated caries prevention, thermal compatibility with enamel and dentin, and a generally mild pulpal response [5][8][14]. Despite these benefits, the material also presents notable limitations. Its relatively low compressive strength, reduced abrasion resistance, and limited fracture toughness confine its use primarily to low stress-bearing areas [5][7]. Esthetic shortcomings and sensitivity to moisture during the early setting phase further constrain its indications. The longevity of glass ionomer cement restorations is influenced by factors such as occlusal loading, internal porosities, early desiccation or water uptake, delayed placement after loss of surface gloss, particle size distribution, and marginal cement thickness.

Glass ionomer cement can be classified according to clinical application, reflecting its versatility across restorative, luting, lining, sealing, orthodontic, and atraumatic restorative procedures. It is also categorized by generational development, illustrating the evolution of its formulation and performance characteristics. First-generation glass ionomer cements were developed to address the shortcomings of silicate cements, particularly their poor clinical durability. Early formulations such as ASPA I exhibited slow setting, high moisture sensitivity, and limited esthetics, which restricted their clinical acceptance. The subsequent incorporation of d-tartaric acid improved handling and translucency, leading to the development of ASPA II and establishing the foundation for modern clinical use [15]. Second-generation glass ionomer cements introduced water-hardening systems in which polyacid components were incorporated into the powder, with setting initiated by water or tartaric acid solutions. These formulations demonstrated improved shelf life, reduced initial viscosity, and enhanced mechanical strength, marking a significant advancement in material performance. Continued efforts to expand the clinical applicability of glass ionomer cement led to the development of reinforced variants designed to address inherent strength limitations [5]. Reinforcement strategies included the incorporation of dispersed phase glasses containing strengthening crystallites, fiber reinforcement using alumina, glass, silica, or carbon fibers, and metal reinforcement through the addition of amalgam alloy powders, commonly referred to as miracle mix [16][17][18][19]. Further refinement resulted in cermet ionomer cements, produced by sintering metal and glass powders to achieve a more robust metal–glass bond [20]. Highly viscous conventional glass ionomer cements were also developed, particularly for atraumatic restorative treatment, allowing placement techniques similar to dental amalgam [21]. Resin-modified and amino acid–modified formulations further expanded the material's mechanical and clinical capabilities [22][23][24].

Metal-modified glass ionomer cements incorporate silver alloy particles into the conventional glass ionomer matrix to enhance mechanical properties and permit limited use in stress-bearing areas such as Class I cavities in primary molars. These materials may be produced as silver alloy–admixed systems or as cermet mixtures. Silver alloy–admixed glass ionomer cement is formulated by combining spherical silver alloy particles with conventional glass ionomer powder, whereas cermet cement involves sintering silver alloy with glass particles at high temperature and pressure, followed by grinding to a fine powder [18]. Metal-modified formulations demonstrate improved wear resistance, with cermet variants outperforming silver alloy–admixed types, though gains in compressive strength and fracture resistance remain modest. Despite mechanical improvements, metal-modified glass ionomer cements exhibit slightly reduced chemical bonding due to the presence of silver particles. Fluoride release remains clinically significant, although cermet cements release less fluoride than silver alloy–admixed systems. Improved handling characteristics and reduced porosity are additional advantages, yet their use in high stress-bearing areas is generally limited to primary dentition. Indications include core build-up procedures and Class I restorations in primary teeth. Resin-modified glass ionomer cement represents a major hybrid development achieved by incorporating resin monomers and photoinitiators into conventional glass ionomer formulations. These materials consist of fluoroaluminosilicate glass powder combined with chemical and light-activated initiators, and a liquid phase containing polyacrylic acid and hydroxyethyl methacrylate. The setting reaction involves both acid–base and polymerization mechanisms, resulting in a dual-curing process. Early resin polymerization creates a protective network that shields the acid–base reaction from moisture contamination, a phenomenon known as the umbrella effect, thereby enhancing early strength and reducing sensitivity during initial setting [25].

The microstructure of resin-modified glass ionomer cement comprises unreacted glass particles embedded within a matrix of polyacid, and resin components linked by hydrogen bonding. Although chemical bonding to tooth structure is preserved, ionic activity is reduced due to resin incorporation, leading to a modest decrease in bond strength. Fluoride release remains present but is slightly lower than that of conventional glass ionomer cement, influenced by complex formation between fluoride ions and polyacrylic acid [13]. The higher initial pH of resin-modified formulations reduces pulpal irritation, while improvements in wear resistance, fracture toughness, and flexural strength enhance clinical durability [2][3]. Increased translucency and minor polymerization shrinkage further characterize these materials. Resin-modified glass ionomer cements are indicated for Class V restorations, noncarious cervical lesions, selected Class I and II restorations in primary teeth, and as liners or bases beneath composite restorations using the sandwich technique [7][26]. Their balanced combination of chemical adhesion, improved mechanical performance, and reduced moisture sensitivity supports broad clinical use. Polyacid-modified composite resins, commonly referred to as compomers, represent another hybrid material that integrates features of composite resins and glass ionomer cements. In these materials, ion-leachable glass particles are incorporated as fillers within a resin matrix, while polyacids are absent. Compomers are supplied as single-component systems and set exclusively through light-induced polymerization [27]. Because the acid–base reaction is absent, chemical bonding to tooth structure does not occur, and adhesion relies on micromechanical retention. The mechanical properties of compomers, including wear resistance, strength, and fractured toughness, exceed those of conventional glass ionomer cement but remain inferior to those of composite resins. Fluoride release is reduced relative to glass ionomer cement, yet esthetic qualities such as translucency and color stability are superior. These characteristics make compomers suitable for applications including pit and fissure sealants, post and core cementation, restorations in deciduous teeth, and Class III and V lesions.

Clinical Significance

Glass ionomer cement occupies a unique position among restorative dental materials because of its close structural and functional resemblance to dentin, a feature that has led to its description as man-made dentin. This designation is justified by its modulus of elasticity, resilience, coefficient of thermal expansion, and thermal conductivity, all of which approximate those of natural dentin. Such similarity allows the material to respond to functional stresses and thermal changes in a manner compatible with tooth structure, thereby reducing interfacial stress and marginal breakdown. In addition to its favorable physical behavior, glass ionomer cement exhibits true chemical adhesion to enamel and dentin, demonstrates high biological compatibility with pulpal and periodontal tissues, and provides sustained fluoride release, which contributes to caries prevention [4][5]. Collectively, these characteristics establish glass ionomer cement as an effective dentin substitute in a wide range of clinical situations [7]. Nevertheless, its relatively low mechanical strength, limited abrasion resistance, and inferior esthetic properties compared with resin-based materials restrict its use in areas subjected to high occlusal load or demanding esthetic requirements [4][5]. For this reason, careful material selection based on clinical demands remains essential. The clinical importance of glass ionomer cement is further emphasized by the versatility of its conventional and modified formulations. One of the most valuable applications is its use as a liner or base beneath restorative materials, particularly resin composites, in the sandwich technique. The inherent resiliency, minimal polymerization shrinkage, and thermal compatibility of glass ionomer cement help protect the pulp and maintain marginal integrity when placed under composite restorations [28]. Unlike many adhesive systems, glass ionomer cement bonds to dentin without complete removal of the smear layer, reducing technique sensitivity and preserving dentinal integrity. Its biocompatibility and fluoride-releasing capacity further enhance its suitability in deep cavities, where pulpal protection and caries prevention are critical.

Glass ionomer cement and its modified derivatives are particularly advantageous in patients with high caries risk. The continuous release of fluoride ions at the tooth–restoration interface promotes remineralization and inhibits demineralization, thereby reducing the incidence of secondary caries. This anticariogenic effect, combined with chemical adhesion to dentin and enamel, makes glass ionomer cement a preferred restorative material for carious lesions in patients with poor oral hygiene, xerostomia, or high cariogenic challenge [29]. In pediatric dentistry, the ease of placement, reduced need for extensive cavity preparation, and snap-set characteristics of light-cured glass ionomer cements make them especially suitable for children, where cooperation may be limited and moisture control is often challenging [7]. The role of glass ionomer cement as a luting agent further underscores its clinical relevance. Conventional and resin-modified formulations have demonstrated reliable performance in the cementation of stainless steel crowns in primary teeth, cast metal crowns, fixed dental prostheses in permanent dentition, space maintainers, and orthodontic bands and brackets. The chemical adhesion to tooth structure, coupled with adequate retention and fluoride release, contributes to long-term clinical success. Resin-modified glass ionomer cement has expanded these indications to include the luting of zirconia and alumina-based ceramic crowns, where improved mechanical properties and reduced moisture sensitivity are advantageous.

Another important clinical application of glass ionomer cement lies in its use for repairing defects in tooth structure prior to crown preparation. By chemically bonding to dentin and releasing fluoride, the material stabilizes weakened tooth structure, seals exposed dentin, and provides a sound foundation for subsequent prosthetic procedures. This stabilizing effect is particularly valuable in teeth with extensive caries or structural compromise, where preservation of remaining tooth tissue is a priority. Glass ionomer cement also plays a significant role in core build-up procedures. Alongside amalgam and composite materials, it is frequently selected for this purpose due to its ability to chemically adhere to tooth structure without the need for complex bonding protocols. This adhesion reduces the risk of core dislodgement and enhances structural integrity. In cervical restorations and pit and fissure sealants, glass ionomer cement has demonstrated satisfactory clinical performance, particularly in situations where moisture control is difficult or fluoride release is desired [4][5][7]. Overall, the clinical significance of glass ionomer cement lies not in replacing all restorative materials but in fulfilling specific roles where its unique combination of chemical adhesion, biological compatibility, fluoride release, and dentin-like physical behavior offers clear advantages. When its limitations are recognized and its indications appropriately selected, glass ionomer cement remains an indispensable material in contemporary restorative and preventive dentistry.

Enhancing Healthcare Team Outcomes

Optimizing patient outcomes when glass ionomer cement is incorporated into clinical care requires a clearly structured, collaborative healthcare team. Each professional group contributes distinct expertise that, when effectively integrated, enhances both the quality and safety of care. Physicians, nurse practitioners, and other advanced practitioners often play a pivotal role in patient assessment, diagnosis, and the formulation of comprehensive treatment plans, particularly in medically complex patients. Dentists and dental hygienists are primarily responsible for the clinical application, selection, and long-term management of glass ionomer cement restorations, ensuring that material choice aligns with anatomical, functional, and preventive goals. Nurses support this process by reinforcing treatment plans, educating patients, and monitoring overall health factors that may influence oral outcomes. Clear delineation of responsibilities prevents role overlap, reduces errors, and promotes workflow efficiency. Equally important is effective communication among all healthcare professionals involved. The timely exchange of patient history, risk factors, procedural details, and follow-up findings allows for coordinated decision-making and continuity of care. Such interprofessional collaboration ensures that the use of glass ionomer cement is consistent with the broader therapeutic objectives, supports patient-centered care, improves clinical outcomes, enhances patient safety, and strengthens overall team performance within diverse clinical settings [7][15].

Nursing, Allied Health, and Interprofessional Team Interventions

Allied health professionals, particularly dental assistants and hygienists, play an essential role in the successful clinical use of glass ionomer cement. Chairside dental assistants are typically responsible for preparing the material according to manufacturer guidelines, which includes accurate proportioning, proper mixing technique on a glass slab or mixing pad, and the use of an agate spatula to avoid material contamination. Their technical proficiency directly influences the physical properties, working time, and clinical performance of the cement. Dental assistants must also ensure that the correct instruments are available, the operative field is adequately isolated, and the dentist receives the material at the appropriate stage of consistency. Nurses and allied health staff further contribute by reinforcing infection control protocols, supporting patient comfort, and assisting with postoperative instructions related to oral hygiene and material care. Interprofessional collaboration extends beyond the dental operatory, as coordination with physicians, dietitians, and pharmacists may be required for patients with systemic conditions affecting oral health. Through structured teamwork and shared clinical responsibility, allied health interventions help ensure accurate material handling, procedural efficiency, and improved patient outcomes [28].

Nursing, Allied Health, and Interprofessional Team Monitoring

Continuous monitoring and follow-up are critical components of care when glass ionomer cement is used in clinical practice. Nurses are central to this process, as they assess patients before and after procedures to identify potential contraindications, allergic responses, discomfort, or unexpected adverse events. Post-procedural monitoring includes evaluating pain levels, soft tissue response, and patient adherence to care instructions. Accurate and comprehensive documentation is essential and should include the specific type of glass ionomer cement used, the clinical indication, procedural details, patient tolerance, and any complications encountered. This documentation supports continuity of care and facilitates communication among healthcare providers. Interprofessional teams, including dentists, nurses, physicians, pharmacists, and other allied health professionals, should jointly evaluate the appropriateness of glass ionomer cement based on the patient's systemic health, oral condition, and long-term treatment goals. Effective interprofessional communication allows for early recognition and management of complications and supports shared learning to improve future practice. Ongoing education and training for all team members are equally important to maintain competence, incorporate emerging evidence, and ensure safe, effective, and up-to-date use of glass ionomer cement in clinical care [29].

Conclusion:

Glass ionomer cement continues to play a vital role in contemporary dentistry due to its unique combination of chemical adhesion, sustained fluoride release, and biological compatibility. Its physical and thermal properties closely resemble those of natural dentin, justifying its designation as a “man-made dentin.” These characteristics make GIC particularly valuable in preventive dentistry, pediatric care, high-caries-risk patients, and situations where moisture control is challenging. The development of modified formulations, including resin-modified and metal-reinforced glass ionomer cements, has addressed several mechanical and handling limitations, expanding clinical applications while preserving core benefits. Nevertheless, conventional and modified GICs remain limited in high stress-bearing and highly esthetic areas because of comparatively lower strength and translucency. Optimal clinical outcomes depend on proper case selection, strict adherence to manipulation protocols, and effective interprofessional collaboration. When used within its indications, glass ionomer cement remains an indispensable material for restorative, preventive, and public health dentistry.

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