

ADVANCED DENTAL CEMENTATION: A FOCUS ON ESTHETICS

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ABSTRACT

Aim of the Study: The aim of this study is to provide a comprehensive analysis of dental cementation techniques, focusing on the advantages and disadvantages of various approaches, as well as their impact on esthetics in restorative dentistry.

Material and Methods: This study employed a systematic approach to gather relevant information, conducting extensive research using electronic databases such as PubMed, Google Scholar, and Web of Science. Articles released from April onwards were targeted, focusing exclusively on English-language publications. A comprehensive set of keywords, including "dental cementation," "advantages," "disadvantages," and "esthetic outcomes," were utilized to ensure thorough coverage of the topic.

Results: The analysis of dental cementation techniques revealed a range of advantages and disadvantages associated with different approaches. These findings provide valuable insights into the impact of various cementation methods on esthetic outcomes in restorative dentistry. Dental cements are engineered to secure restorations, appliances, and post-and-core systems in a stable and durable manner within the oral environment. Conventional glass ionomer and zinc phosphate cements are among the most widely used materials for luting metallic restorations and posts. In contrast, resin-based cements are favored for esthetic applications. The successful cementation of esthetic restorations largely depends on the proper treatment and silane application to the internal surface of the restoration.

Conclusions: The findings of this study highlight the importance of carefully considering the advantages and disadvantages of dental cementation techniques in restorative dentistry. Understanding the impact of these methods on esthetic outcomes is crucial for optimizing patient care and treatment outcomes. Further research in this area is warranted to continue improving dental cementation practices and enhancing esthetic results for patients.

Key-words: dental cementation, esthetics, functionality, advancements, clinical considerations.

INTRODUCTION

Dental cements are essential for the stable and enduring retention of restorations, appliances, and post and core systems within the oral cavity [1].

Among the most commonly employed materials for luting metallic restorations and posts are conventional glass ionomer and zinc phosphate cements, whereas resin-based cements are predominantly utilized for esthetic applications [2].

The successful cementation of aesthetic restorations critically hinges on the meticulous treatment and silane application to the internal surfaces of these restorations [3].

It is generally recommended that clinicians employ a three-step total-etch or a two-step self-etch adhesive system for luting purposes to circumvent potential incompatibilities between adhesives and chemical- or dual-cure cements [4].

A dependable cementation process necessitates a comprehensive understanding of the underlying mechanisms and the limitations of the materials used [5].

Dental cements are critical for securing restorations, appliances, and posts and cores in a stable and durable manner within the oral cavity. The retention mechanisms for cemented restorations include chemical bonding, mechanical friction, and micromechanical hybridization, often involving a combination of these methods depending on the cement type and substrate [6].

Permanent dental care and cosmetic treatments aimed at dental aesthetics have a positive influence on individuals' psycho-emotional state. Social life is improved for those who take care of their oral hygiene.

Dental conditions such as cavities, gum diseases, and tooth extractions have been associated with an increased risk of

cognitive impairment. These oral conditions are often correlated with cognitive deteriorative conditions. It is known that individuals affected by dementia suffer from apraxia, which prevents them from having good manual skills for oral hygiene or even makes them forget to clean their oral cavity, a sign of cognitive impairment. Therefore, there is a causal relationship between severe dental conditions and the diagnosis of cognitive impairment or dementia.

Proper oral hygiene and a concern for one's dental aesthetics are signs of psycho-emotional health that involve mechanisms of health care, personal concern, and a balanced cognitive status.

For dental cements to perform effectively in clinical settings, they must exhibit resistance to dissolution in the oral environment, robust mechanical interlocking and adhesion, high tensile strength, suitable working and setting times, and biological compatibility with the substrate [7].

A variety of dental cements are commercially available, including resin-based and non-resin-based options. Traditionally, zinc phosphate cement has been the most popular luting material, despite its notable disadvantages, such as solubility and lack of adhesion [8].

Glass ionomer luting cements are also highly regarded by clinicians, primarily due to their fluoride release, which can help prevent recurrent caries. Resin-based cements, preferred for esthetic restorations (ceramic or resin-based), have gained popularity for overcoming the issues of solubility and lack of adhesion associated with earlier materials. The introduction of adhesive luting cements has significantly broadened the capabilities of fixed prosthodontics [9].

Restorative dentistry is continually evolving, driven by the clinical application of existing dental materials and the development

of new ones [10].

Despite the advancements, there is no universally ideal luting cement for all clinical situations. The properties and performance of dental cements are widely debated, as each material offers distinct advantages and disadvantages [11].

MATERIALS AND METHODS

This article provides a comprehensive analysis of common dental cements, with a particular emphasis on resin-

based cements for esthetic restorations, reflecting their prominent discussion in contemporary literature [12].

The following table summarizes the key characteristics of various dental luting cements currently in use.

Table 1. Current material classes of dental luting cements

Material	Area of Application	Strengths	Weaknesses
Zinc Phosphate Cement	Routine application in metal-supported crowns, bridges, and posts	Over 100 years of clinical experience	Occasional postoperative sensitivity, low hardness, high solubility
Glass Ionomer Cement	Routine application in metal-supported crowns and bridges. Limited application with high-strength ceramics during curing	20 years of clinical experience, fluoride release, molecular bonding to tooth substance, minimal dimensional change, simplicity of use	Medium strength, occasional postoperative sensitivity, sensitivity to water and mechanical loading
Resin-Modified Glass Ionomer Cement	Routine application in metal-supported crowns, bridges, and posts (esthetic). Limited application with lab-manufactured composite works. Limited application with high-strength ceramics	Good routine cement, fluoride release, medium strength, molecular bonding to tooth structure, low solubility, less technique-sensitive, little postoperative sensitivity	Moisture-sensitive powder, swelling, not indicated for most ceramics
Adhesive Resin Cement	All metal-based ceramics, lab-manufactured composite works, and posts (esthetic)	Over 10 years of successful application, high adhesion qualities with pretreatment, high hardness, low solubility, high mechanical properties, good esthetics	Difficulty of handling, requires use of separate primers or adhesives, too strong for certain applications, no fluoride release, occasional postoperative sensitivity

This table summarizes the characteristics of various dental luting cements, highlighting their areas of application, strengths, and weaknesses. Such an overview assists clinicians in selecting the appropriate cement for specific clinical scenarios, thereby enhancing the outcomes of restorative procedures [13].

RESULTS

Zinc compounds have garnered significant attention in dental medicine due to their diverse properties and applications. This review offers a comprehensive examination of various zinc compounds used in dental practice, emphasizing their characteristics, mechanisms of action, and clinical applications. The objective is to consolidate current knowledge on zinc compounds and their potential in contemporary dental medicine [14].

The properties and characteristics of zinc oxide are highlighted, particularly its antibacterial, antifungal, and anti-inflammatory effects. Clinical applications of zinc oxide in dental materials are explored, including its use in temporary fillings, cements, and impression materials. Zinc phosphate cements are reviewed, detailing their composition, setting reaction, and physical properties, along with their clinical applications in restorative dentistry, such as crown and bridge cementation, liners, and bases [15].

The properties and applications of zinc polycarboxylate cements are discussed, with an emphasis on their adhesive and biocompatible characteristics. The antimicrobial and astringent properties of zinc chloride are examined, as well as its applications in periodontal treatments and dental materials. Additionally, zinc-based antimicrobial agents, including zinc ions and zinc nanoparticles, are evaluated for their

potential use in oral healthcare. Their antibacterial, antifungal, and antiviral properties are assessed, highlighting their application in preventive dentistry and restorative procedures [16,17].

Zinc phosphate cement is widely utilized in luting restorations, including the cementation of fixed cast alloys and porcelain restorations. Additionally, it serves as a cavity liner or base, providing protection to the pulp from mechanical, thermal, and electrical stimuli [18].

The retention of restorations cemented with zinc phosphate, a non-adhesive luting material, primarily relies on the geometric configuration of the tooth preparation, which restricts the paths of displacement for the cast restoration. Interestingly, zinc phosphate cement can be considered the first "self-etch cement" due to its acidity, which can demineralize the dentin surface and expose collagen fibrils [19].

However, a traditional hybrid layer cannot form because the acidic liquid separates from the particles, preventing infiltration into the interfibrillar spaces. To mitigate potential hazards to the pulp from this demineralization, it is recommended to cover the dentin with a layer of copal varnish before luting with zinc phosphate cement [20].

The adhesive properties of zinc phosphate cement were not fully appreciated in its early use in prosthodontics. Zinc polycarboxylate cement, developed in 1968, aimed to combine the strength of zinc phosphate with the adhesiveness and biocompatibility of zinc oxide eugenol [21].

It is composed of zinc oxide and polyacrylic acid in a powder and liquid system, which sets through an acid-base reaction in an aqueous environment. During this reaction, zinc ions crosslink the polyacrylic acid chains, resulting in the setting of the cement [22].

The carboxylic groups of the polyacrylic acid can chelate calcium in hydroxyapatite, creating a chemical bond with the mineralized hard tissues. However, this chemical adhesion is weak, and retention is primarily mechanical [23].

The main advantages of zinc polycarboxylate cement include its reduced pulp irritation and higher tensile strength compared to traditional zinc phosphate cement. However, its compressive strength is only one-half to two-thirds that of zinc phosphate, and its modulus of elasticity is much lower, which can lead to significant plastic deformation under long-term loading [24].

Additionally, zinc polycarboxylate cement has low resistance to acidic erosion, making it unsuitable for patients with gastric reflux or those who frequently consume an acidic diet [25].

Clinically, the handling properties of zinc polycarboxylate are less favorable due to its high viscosity and short working time of 2.5 minutes, posing challenges, particularly when cementing multiple-unit restorations [26].

Glass ionomer cements are frequently employed for the cementation of cast alloy and porcelain restorations. These cements offer numerous clinical benefits, such as physicochemical bonding to tooth structures, sustained fluoride release over time, and minimal coefficients of thermal expansion. However, their relatively low mechanical strength limits their suitability for use in areas subjected to high stress [27].

The primary advantage of glass ionomer cements lies in their ability to form a permanent bond to the hydrophilic surfaces of oral hard tissues, effectively sealing

margins at tooth-material interfaces during restorative and luting procedures [28].

Over time, advancements in formulation have resulted in hybrid materials containing varying amounts of resin monomers. If the material sets via the acid-base reaction without requiring light activation, it is classified as a resin-modified glass ionomer cement. Conversely, if the setting mechanism primarily relies on light curing of the resin monomers, the material is more likely a polyacid-modified resin composite (compomer), not falling under the category of glass ionomer cements [29].

Resin-modified glass ionomer cements represent significant improvements over traditional counterparts, being the most widely utilized material within their class. Their advantages include dual-curing capabilities (light activated and self-curing), fluoride release, and higher flexural strengths compared to conventional glass ionomer cements [30].

They also offer enhanced handling properties, including compatibility with composite materials. However, despite their popularity, glass ionomer cements have drawbacks. One issue is their inconsistent promotion of sufficient bond strength to enamel and dentin. Furthermore, they tend to absorb moisture from the surrounding environment, which can result in the leaching of ions, swelling, and weakening if exposed prematurely [31].

Conversely, loss of water can result in shrinkage and cracking of the cement. Generally, bond strengths are greater to enamel than to dentin, indicating bonding occurs via chelation of calcium ions at the surface of hydroxyapatite [32].

Table 2. Advantages and disadvantages of glass ionomer cements

Advantages	Disadvantages
Physicochemical bonding to tooth structures	Inconsistent bond strength to enamel and dentin
Long-term fluoride release	Water absorption leading to leaching, swelling, weakening
Low coefficients of thermal expansion	Shrinkage and cracking with water loss
Dual-curing mode (light activated and self-curing)	
Higher flexural strengths compared to conventional glass ionomer cements	
Enhanced handling properties	
Capability of bonding to composite materials	

Glass ionomers remain unique among dental materials in their ability to self-adhere to tooth tissue without requiring surface pretreatment. However, studies have shown that pretreatment with a mild polyalkenoic acid conditioner significantly enhances their bonding and sealing effectiveness. This additional conditioning step becomes particularly crucial when using coarse cutting diamonds, which can produce thicker smear layers [33].

The improved bonding efficiency can be attributed partly to a "cleaning effect," whereby loose cutting debris is removed, and partly to a partial "demineralization" effect, which increases the surface area and exposes microporosities for micromechanical interlocking or hybridization. More recently, research has demonstrated chemical adhesion to partially demineralized dentin, further enhancing bond stability. In this regard, glass ionomers can be viewed as adhering to tooth tissue through a self-etch approach [34].

The key distinction from resin-based self-etch systems lies in the mechanism: glass ionomers self-etch using a relatively high molecular weight polycarboxyl-based polymer, while resin-based self-etch

adhesives employ acidic low molecular weight monomers [35].

CONCLUSIONS

Dental cementation plays a pivotal role in restorative dentistry, serving as the foundation for securing various restorations, appliances, and post-and-core systems within the oral cavity. This process not only ensures stability and longevity of the restorative work but also influences the overall esthetic outcome of dental treatments. Among the diverse array of dental cements available, conventional glass ionomer and zinc phosphate cements stand out as popular choices for luting metallic restorations and posts, while resin-based cements are preferred for their esthetic applications.

Glass ionomer cements offer several advantages, including physicochemical bonding to tooth structures, sustained fluoride release, and minimal coefficients of thermal expansion. However, their relatively low mechanical strength limits their use in high-stress-bearing areas. On the other hand, resin-modified glass ionomer cements represent an improvement over traditional glass ionomer cements, boasting dual-curing capabilities, fluoride release, and enhanced

flexural strength. Yet, challenges persist, such as inconsistent bond strength to enamel and dentin, water absorption leading to leaching, swelling, and weakening, as well as handling difficulties due to high viscosity and short working time.

Despite these limitations, glass ionomer cements remain unparalleled in their ability to self-adhere to tooth tissue without requiring surface pretreatment, making them unique among dental materials. Pretreatment with a mild polyalkenoic acid conditioner can further enhance their bonding efficiency, especially in scenarios involving coarse cutting diamonds and thicker smear layers. The self-adhesive nature of glass ionomers,

coupled with advancements in bonding techniques, underscores their significance in modern restorative dentistry.

In conclusion, while dental cements play a critical role in achieving functional and esthetic outcomes in restorative dentistry, careful consideration of their advantages and disadvantages is paramount in selecting the most appropriate material for each clinical scenario. With ongoing advancements in material science and bonding technologies, the quest for an ideal dental cement continues, with the ultimate goal of improving patient outcomes and enhancing the quality of dental care.

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