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Characteristics of Luting Cements in the Selection of Cementation Materials for Fixed Partial Dentures: A Narrative Review

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ABSTRACT

Background: A Fixed Partial Denture (FPD) is a permanent prosthesis cemented to abutment teeth using luting cement. One of the most common complications is retention loss, which is closely related to the type and properties of the cementation material used. **Objective:** This narrative review aims to analyze the characteristics of luting cements to determine the ideal material for cementing FPDs. **Methods:** A literature review was conducted using articles from PubMed, ScienceDirect, and Google Scholar databases published within the last 15 years. Inclusion and exclusion criteria were applied, and the selected studies were assessed for bias using the Checklist for Reporting In-vitro Studies (CRIS). **Results:** A total of 21 in vitro studies were reviewed. Sixteen studies reported that resin cement has the highest retention. Ten studies supported the use of zinc phosphate (ZP), zinc polycarboxylate (ZPC), glass ionomer cement (GIC), and resin cement for all-metal FPDs. Six studies favored resin cement for all-ceramic FPDs, while four studies showed positive outcomes using resin cement for porcelain-fused-to-metal (PFM) FPDs. **Conclusion:** Resin cement demonstrates superior retention characteristics, making it the ideal luting agent for FPDs. ZP, ZPC, and GIC also provide good performance for all-metal FPDs. In contrast, resin-modified glass ionomer cement (RMGIC) shows inferior retention and is less recommended for FPD cementation.

Keywords: Fixed Partial Denture, Luting Cement, Resin Cement, Retention, All-Metal FPD, All-Ceramic FPD

1. Introduction

A fixed partial denture (FPD) is a prosthesis designed to replace one or more missing teeth with artificial substitutes that are permanently attached to the remaining natural teeth or dental implants. Its primary objectives are to restore masticatory and speech functions, reestablish facial profile and patient aesthetics, and achieve optimal occlusion.[1–3] One of the most common mechanical complications encountered in FPDs is the loss of retention.[4,5] Improper selection of luting cement has been identified as a contributing factor to this failure.[6,7] Therefore, the appropriate choice of cement is crucial to ensure the success and long-term stability of FPD restorations.[7–9]

Luting cements serve to bond the FPD to the abutment by filling the space between the restoration and the abutment surface, thus preventing movement or dislodgement.[7–9] Common types of luting cements include zinc phosphate (ZP), zinc polycarboxylate (ZPC), glass ionomer cement (GIC), resin-modified glass ionomer cement (RMGIC), and resin cement.[9,10] Historically, ZP was the only available luting cement throughout the 20th century and remains a gold standard in definitive cementation.[5,10,11] It has demonstrated favorable long-term clinical performance and has been widely used for decades.[12,13] In support of this, Masaka et al. reported that the survival rate of FPDs cemented with ZP was 93.7% over 5 years and 76.1% over 15 years.[14] Similarly, Aladag et al. found that all-metal FPDs cemented with ZP exhibited superior retention compared to those cemented with ZPC, RMGIC, or resin cement.[15] However, other studies by Gemalmaz et al. and Jacob et al. reported drawbacks of ZP, including significant volume loss, material disintegration, and a high degree of microleakage.[16,17]

Numerous studies have explored cementation materials for indirect restorations; however, no clear consensus has been reached on the ideal luting cement for FPDs.[7–9] With advancements in dental materials, a variety of cements with differing compositions, bonding mechanisms, and properties have been developed.[7,18] Despite this, none of the existing luting cements fulfill all the criteria of an ideal luting material.[8,9] Moreover, cements cannot be universally applied across all restoration types, making it essential to understand their characteristics to determine the appropriate material for each clinical situation.[9] Properties such as shear bond strength (SBS), tensile bond strength (TBS), compressive strength, and resistance to microleakage are crucial indicators of a cement's retention performance and play a significant role in material selection for FPDs.[1,2,10]

Resin cement is widely recognized for having the highest retention capacity due to its superior bonding strength compared to other types of luting cements.[1,10,19] Bishti et al. confirmed this by demonstrating that resin cement outperformed ZPC and GIC in terms of retention when used with all-metal FPDs.[20] In contrast, Priyanka et al. found that GIC provided better retention than resin cement in certain all-metal FPD applications.[21] Additionally, El Halawani et al. reported that all-ceramic FPDs cemented with resin cement achieved a microleakage resistance success rate of 81.25% to 95%.[22] However, Al-Dwairi et al. observed a 53.42% debonding rate in all-ceramic FPDs using resin cement.[23]

Given the increasing demand for long-lasting and functionally reliable FPDs, identifying an optimal luting cement is of critical importance. Selecting the appropriate cement not only enhances the clinical outcome but also reduces the risk of prosthesis failure and subsequent complications. This study contributes to clinical decision-making by synthesizing evidence on the performance characteristics of various luting agents concerning FPD retention. This literature review aims to analyze and compare the characteristics of various luting cements used in the cementation of fixed partial dentures, with an emphasis on their retention performance, mechanical strength, and resistance to microleakage. Resin cement demonstrates superior retention characteristics compared to other types of luting cements (ZP, ZPC, GIC, RMGIC) in the cementation of fixed partial dentures.

2. Materials and Methods

2.1. Literature Search Strategy

A comprehensive literature review was conducted using three major databases: PubMed, ScienceDirect, and Google Scholar. The search included studies published within the last 15 years, from 2009 to 2024. Keywords used in the search included "luting cement," "fixed partial denture," "retention," "shear bond strength," and "microleakage." Boolean operators (AND, OR) were used to refine the search results and identify relevant studies.

2.2. Inclusion and Exclusion Criteria

Studies were screened based on predefined inclusion and exclusion criteria to ensure relevance and quality. The inclusion criteria consisted of original in vitro research articles that specifically investigated the physical or mechanical characteristics of luting cements, including resin cements, glass ionomer cements (GIC), zinc phosphate (ZP), zinc polycarboxylate (ZPC), and resin-modified glass ionomer cements (RMGIC). Only studies focusing on the cementation of fixed partial dentures—whether all-metal, all-ceramic, or porcelain-fused-to-metal (PFM)—and published in English were considered eligible. Conversely, articles were excluded if they were review papers, case reports, or editorials. Additionally, studies involving removable prostheses or orthodontic appliances, as well as those with incomplete data or lacking quantitative outcomes, were omitted from this review. The specific inclusion and exclusion criteria are detailed in Table 1.

2.3. Bias Assessment

To assess the methodological quality and risk of bias, all selected articles underwent evaluation using the Checklist for Reporting In Vitro Studies (CRIS). This checklist was employed to ensure the internal validity and reproducibility of the included studies.

2.4. Data Extraction and Analysis

After screening and quality assessment, the selected articles were reviewed in full. Relevant data on the types of luting cement, their characteristics (e.g., shear bond strength, tensile strength, compressive strength, and microleakage), and the type of FPD (all-metal, all-ceramic, or PFM) were

extracted. The data were analyzed qualitatively and synthesized to evaluate the suitability of each luting cement type for different clinical scenarios.

Table 1. Inclusion and Exclusion Criteria

Criteria Type	Criteria Description
Inclusion	In vitro studies related to luting cements used for FPD cementation, Studies published between 2009 and 2024, Articles written in English- Studies that assess mechanical properties such as shear bond strength (SBS), tensile strength (TBS), compressive strength, or microleakage, Research involving all-metal, all-ceramic, or porcelain-fused-to-metal (PFM) FPD
Exclusion	Review articles, case reports, or editorials, Studies involving removable prostheses or orthodontic appliances, Studies lacking quantitative results, Non-English language articles, Studies not using standard testing protocols.

3. Result and Discussion

This narrative review analyzed 21 in vitro studies on the characteristics of luting cements for fixed partial dentures (FPDs). The studies evaluated key mechanical properties, including shear bond strength, tensile strength, compressive strength, and microleakage. Resin cement was most frequently identified as having superior retention, especially for all-metal and all-ceramic FPDs. In contrast, zinc phosphate (ZP), zinc polycarboxylate (ZPC), and glass ionomer cement (GIC) showed reliable performance for all-metal restorations. Resin-modified glass ionomer cement (RMGIC) consistently demonstrated lower retention and higher microleakage. The discussion compares the mechanical and clinical implications of each cement type across different FPD substrates, considering variations in methodologies and cement formulations. A PRISMA flow diagram summarized the systematic selection process: 270 records were identified, 232 screened after duplicates were removed, 50 full texts were reviewed, and 21 studies were included in the final synthesis. This ensures a transparent and rigorous review process (Figire 1).

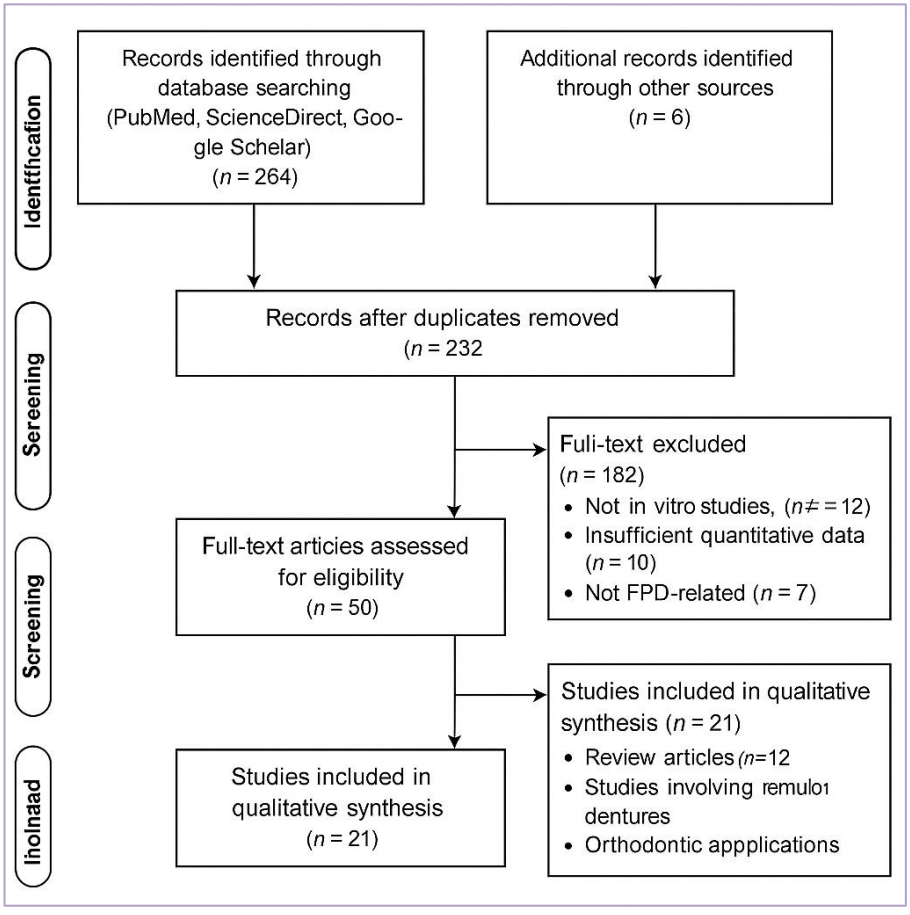

Figure 1. PRISMA Flow Diagram of the Literature Selection Process for Studies on Luting Cements in Fixed Partial Denture Cementation

Table 2 summarizes the distribution of the included studies based on the performance characteristics of different luting cements used in the cementation of fixed partial dentures (FPDs). Among the 21 in vitro studies analyzed, resin cement was most frequently reported to provide the highest retention values across various FPD substrates, as indicated in 16 studies. Zinc phosphate (ZP), zinc polycarboxylate (ZPC), and glass ionomer cement (GIC) were each highlighted in 10 studies as demonstrating good retention, particularly for all-metal FPDs. These findings suggest that conventional cements, despite their long history of use, still offer reliable clinical outcomes in specific prosthodontic applications.

For all-ceramic FPDs, six studies concluded that resin cements exhibit superior performance in terms of retention and resistance to microleakage, emphasizing their compatibility with ceramic substrates. In addition, four studies identified resin cement as a favorable option for porcelain-fused-to-metal (PFM) restorations, reinforcing its versatility across different prosthesis types. Conversely, resin-modified glass ionomer cement (RMGIC) was consistently associated with lower retention values and increased microleakage when compared to other cements. This suggests that while RMGIC offers certain handling advantages, it may not be the optimal choice for FPD cementation, where high retention and marginal integrity are crucial. These findings highlight resin cement as the most reliable luting agent for achieving long-term retention in FPDs, while also confirming the continued relevance of ZP, ZPC, and GIC for all-metal restorations.

Table 2. Performance of Luting Cements in Fixed Partial Denture Cementation

Luting Cement Type	Application (FPD Type)	Mechanical Characteristics Evaluated	Key Findings	Number of Studies (n)
Resin Cement	All-metal, All-ceramic, PFM	Shear bond strength (SBS), Tensile bond strength (TBS), Microleakage, Compressive strength	Demonstrated the highest retention values and superior bond strength across different FPD substrates; provided excellent marginal integrity, especially with ceramic and PFM restorations.	16
Zinc Phosphate (ZP)	All-metal FPD	Compressive strength, Retention force, Microleakage	Showed consistent retention and long-term clinical success; suitable for conventional all-metal FPDs, though susceptible to microleakage in marginal gaps.	10
Zinc Polycarboxylate (ZPC)	All-metal FPD	Adhesive strength, Microleakage	Provided acceptable retention for metal restorations; chemical adhesion to tooth structure noted; slightly lower mechanical strength compared to ZP and resin cement.	10
Glass Ionomer Cement (GIC)	All-metal FPD	Compressive strength, Microleakage, Bond durability	Exhibited satisfactory retention and fluoride release; good for metal-based restorations, but marginally lower retention values compared to resin cement.	10
Resin Cement (Ceramic)	All-ceramic FPD	SBS, TBS, Microleakage	Achieved superior retention with high resistance to microleakage; compatible with ceramic substrates; supports adhesive bonding protocols.	6
Resin Cement (PFM)	Porcelain-fused-to-metal FPD	SBS, Microleakage	Provided strong bonding and good marginal adaptation in PFM restorations; high retention values noted compared to conventional cements.	4
Resin-Modified GIC (RMGIC)	All FPD types	SBS, Microleakage	Demonstrated lower retention and higher microleakage compared to other cements; better handling properties, but not ideal for long-span FPD cementation.	Reported trend

Data Processing, 2025

Retention loss is a common mechanical complication observed in fixed partial dentures (FPDs) and is frequently associated with the choice of luting cement. Inadequate cement selection can lead to adhesion failure and prosthesis dislodgement, underscoring the importance of understanding luting cement properties to optimize clinical outcomes.[24,25]

3.1. Resin Cement as the Gold Standard for Retention

Resin cement consistently demonstrated the highest retention and bond strength among the reviewed luting agents. Its ability to create both micromechanical interlocking and chemical bonds with tooth structures and restorative materials provides a significant clinical advantage, especially in minimally retentive abutments or suboptimal preparation designs. Sixteen studies confirmed that self-adhesive, self-cured, dual-cured, and light-cured resin cements achieved excellent retention across all-metal, all-ceramic, and porcelain-fused-to-metal (PFM) FPDs when tested using shear bond strength (SBS), tensile bond strength (TBS), compressive strength, and microleakage protocols.[20,22,26–39] Self-adhesive resin cement demonstrated superior retention and lower microleakage compared to glass ionomer cement (GIC), zinc polycarboxylate (ZPC), and resin-modified glass ionomer cement (RMGIC), as supported by Bishti et al., El Halawani et al., and Oyague et al.[20,22,31] The strong bond formation between resin cement and metal substrates, particularly CoCr and titanium abutments, is attributed to its acidic monomers reacting with the oxide layer, enhancing both retention and marginal integrity.

3.2. Limitations of Resin Cement on Zirconia Substrates

Despite its superior overall performance, several studies reported that self-adhesive, dual-cured, and self-cured resin cements showed insufficient retention for all-ceramic zirconia and some all-metal FPDs.[21,23,34,40] Sillam et al., Brunner et al., Al-Dwairi et al., and Priyanka et al. noted that the absence of a glass phase in zirconia inhibits the micromechanical interlocking necessary for optimal adhesion. Six other studies supported these findings and emphasized the critical role of retainer and framework design in improving retention.[21,23,26,28–30,32,33,36,38,39] Brunner et al. also reported that light-cured and dual-cured resin cements achieved excellent retention in lithium disilicate FPDs, while self-cured resin cement performed well in PFM restorations.[21,23,34]

3.3. Conventional Cements for All-Metal FPDs

Zinc phosphate (ZP), ZPC, and GIC continue to demonstrate clinical relevance for all-metal FPD cementation. ZP has been considered a traditional gold standard due to its compressive strength and long-term survival rates.[20,21] ZPC's chemical adhesion to enamel and dentin offers acceptable initial retention, while GIC provides the added benefit of fluoride release, potentially aiding in caries prevention. Bishti et al. showed that after thermocycling simulating one year of aging, resin cement exhibited increased retention, GIC showed stable moderate retention, while ZPC displayed a significant decrease in bond strength, confirming its limitation as a semi-permanent cement of approximately one-year clinical lifespan.[20] GIC's hydrophobic gel matrix after setting demonstrated better stability under thermocycling, making it more suitable for longer semi-permanent use compared to ZPC.[20]

3.4. Microleakage and RMGIC Performance

Microleakage remains a critical factor affecting FPD longevity. Some studies on crown cementation reported that RMGIC demonstrated lower microleakage than ZP and GIC, suggesting its potential as a luting agent.[41–44] However, Oyague et al. observed that self-adhesive resin cement produced significantly lower microleakage compared to RMGIC when bonded to titanium abutments.[31] This was attributed to the phosphate radical interaction of resin cement with the titanium oxide layer, forming stronger chemical bonds. Although RMGIC demonstrated better marginal adaptation due to its greater plastic deformation during seating, its overall retention and hydrolytic stability were consistently inferior, making it less suitable for long-span or high-stress FPD applications.[31]

3.5. Role of Prosthesis Design and Surface Treatment

Multiple studies highlighted that the retention of luting cement is not solely dependent on the material properties but also on FPD design and surface treatment. Shrivastav et al. demonstrated that ZP relies heavily on micromechanical surface irregularities created through surface treatment for optimal retention. Doh et al. and eleven other studies reported that proper framework and retainer design significantly enhances ZPC and resin cement retention.[21,23,26,28–33,36,38,39,45,46] This reinforces the importance of combining material selection with prosthesis design modifications and surface conditioning protocols to achieve long-term success.

3.6. Clinical Implications

The evidence from this review indicates that resin cement should be prioritized for all-ceramic and PFM restorations requiring high retention and minimal microleakage.[20,22,26–39] Self-adhesive resin cement offers additional benefits in reducing technique sensitivity while ensuring strong bonding to metallic substrates. Conventional cements such as ZP, ZPC, and GIC remain highly relevant for all-metal FPDs due to their cost-effectiveness and predictable clinical outcomes.[20,21] RMGIC should be reserved for low-stress cases or situations where fluoride release provides added value over maximum retention. Collectively, these findings highlight that optimal cement selection, combined with appropriate FPD design and surface treatment, is essential to improving prosthesis survival rates and clinical longevity.[20,21,31,45,46]

4. Conclusion

This narrative review highlights that the selection of luting cement is a critical factor in determining the retention, marginal integrity, and overall longevity of fixed partial dentures (FPDs). Resin cement consistently demonstrated superior performance across all-metal, all-ceramic, and porcelain-fused-to-metal (PFM) restorations due to its strong micromechanical and chemical bonding capabilities, as well as its lower microleakage. Conventional cements, including zinc phosphate (ZP), zinc polycarboxylate (ZPC), and glass ionomer cement (GIC), remain reliable options for all-metal FPDs due to their proven clinical track record and cost-effectiveness. Resin-modified glass ionomer cement (RMGIC), while offering handling advantages and fluoride release, showed lower retention and higher microleakage, making it less suitable for high-stress or long-span FPD applications. These findings emphasize the importance of integrating material selection with proper prosthesis design and surface treatment to achieve optimal clinical outcomes.

5. Limitations

This review is limited by the reliance on in vitro studies, which may not fully replicate intraoral conditions such as occlusal forces, saliva contamination, and long-term aging effects. Variations in study methodologies, sample preparation, and testing protocols may also introduce heterogeneity in the results. Additionally, the lack of standardized testing across all studies makes direct comparison between cement types challenging. Further long-term clinical trials are necessary to validate these findings and establish definitive guidelines for selecting luting cement in FPD restorations.

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Authors Contribution

Contribution	Alya A	Rais SW	Kesumaputri BA	Mozartha M
Concepts or ideas	√	√	√	√
Design	√	√	√	√
Definition of intellectual content	√			
Literature search	√	√	√	√
Experimental studies	√	√	√	√
Data acquisition	√			
Data analysis	√	√	√	√
Statistical analysis	√	√	√	√
Manuscript preparation	√			
Manuscript editing	√	√	√	√
Manuscript review	√	√	√	√

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