Review Article

WATER FLOSSER'S IMPACT ON MICROLEAKAGE IN SELF-ADHESIVE RESIN CEMENT AND RESIN-MODIFIED GLASS IONOMER CEMENT

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ABSTRACT

Microleakage at the tooth-restoration interface poses a significant challenge in restorative dentistry, contributing to secondary caries, pulpal inflammation, and restoration failure. This systematic review examines the effect of water flossing on microleakage in self-adhesive resin cement (SARC) and resin-modified glass ionomer cement (RMGIC). Evidence was synthesized from studies that evaluated microleakage from water flossers using dye penetration and other analytical techniques under simulated clinical conditions. The results show that water flossers significantly reduce microleakage in SARC restorations by increasing marginal integrity and bond strength, outperforming traditional brushing methods. In contrast, their effect on RMGIC was modest, potentially due to the material's distinct adhesive properties and composition. Water flossers were found to effectively clean interproximal and subgingival areas, contributing to improved restoration longevity and reduced plaque accumulation. However, the variability in experimental protocols highlights the need for standardized methodologies in future research. This review emphasizes the clinical value of water flossers as a supplementary oral hygiene tool, especially for patients with SARC restorations. Further long-term clinical studies are recommended to confirm these findings and optimize water flosser settings for different dental materials.

Key words: Water flossers, Microleakage, Self-adhesive resin cement (SARC), Resin-modified glass ionomer cement (RMGIC), Restorative dentistry, Oral hygiene.

Introduction

Overview of microleakage and its relevance in clinical dentistry

Microleakage, defined as the penetration of fluids, bacteria, and molecules at the interface of dental restoration and the tooth, is a significant concern in restorative dentistry. It is associated with various adverse outcomes, such as secondary caries, pulpal inflammation, and eventual restoration failure (Krishnan, 2019). The prevention of microleakage is particularly critical in Class V restorations, where differences in enamel and dentin adhesion present additional challenges. Measuring and minimizing microleakage is vital to improving the longevity and clinical success of dental restorations.

Microleakage, the infiltration of fluids and bacteria at the interface of dental restorations, remains a critical concern in restorative dentistry. Saliva contamination is one factor that significantly impacts microleakage, as demonstrated by Hatirli and Boyraz (2022), who evaluated various restorative materials under contaminated and non-contaminated conditions [2]. Their study revealed that alkasite materials, such as Cention N, showed better resistance to microleakage compared to high-viscosity glass ionomer cement, particularly when used with an adhesive. These findings highlight the importance of selecting materials with superior sealing capabilities to enhance restoration longevity, especially in challenging clinical environments.

Advancements in luting agents and restorative techniques have further refined the clinical outcomes of dental restorations. Studies comparing resin-modified glass ionomer cement (RMGIC) and self-adhesive resin cement have shown differences in their performance under varied conditions. For instance, research evaluating fiber post-retention revealed that self-adhesive resin cement exhibited superior retention compared to RMGIC, regardless of the timing of coronal preparation after cementation [3]. Similarly, the use of proximal box elevation (PBE) techniques with composite resins has been shown to improve marginal adaptation and address subgingival margins effectively [4]. While these advances demonstrate promising results, they underscore the necessity for continued research and clinical trials to optimize restorative strategies.

Comparison between self-adhesive resin cement (SARC) and resin-modified glass ionomer cement (RMGIC)

Among luting agents, self-adhesive resin cement (SARC) and resin-modified glass ionomer cement (RMGIC) are commonly used due to their adhesive properties, ease of application, and clinical versatility. SARC demonstrates better marginal adaptation and reduced susceptibility to microleakage due to its resinous composition, which provides superior bonding to enamel and dentin. In contrast, RMGIC is valued for its fluoride release, which offers

additional protection against secondary caries, and its biocompatibility [5]. However, both materials exhibit certain limitations under clinical conditions, including exposure to mechanical and thermal stress, which can affect their marginal integrity [6].

Role of oral hygiene in preventing secondary caries and restoration failure

Plaque biofilm accumulation remains a leading cause of periodontal disease and secondary caries, compromising the success of restorative treatments. Effective plaque control is essential for maintaining oral health and ensuring the longevity of dental restorations. While traditional floss and toothbrushes are widely recommended, advanced tools such as water flossers have gained recognition for their ability to clean areas that are difficult to reach with conventional methods, including subgingival regions and around fixed prostheses [6].

Introduction to water flossers as a supplementary oral hygiene tool

Water flossers, which deliver pulsating streams of water, are effective in disrupting and removing plaque biofilms. Their efficacy has been particularly highlighted in maintaining hygiene around restorative margins, where manual cleaning can be less effective. Preliminary studies have shown that water flossers may influence the marginal microleakage of various luting agents, including RMGIC and SARC. For instance, Al Sughaier et al. (2023) demonstrated mild changes in the margins of crowns cemented with these materials when exposed to water flossing [6]. However, SARC displayed a reduced effect on microleakage compared to RMGIC, emphasizing the material-dependent outcomes of such interventions.

Objectives of the review

This review aims to explore the impact of water flossers on the microleakage of SARC and RMGIC. By synthesizing evidence from various studies, this paper seeks to provide insights into their comparative performance, evaluate the clinical implications of water flossers as a supplementary oral hygiene tool, and guide clinicians in selecting restorative materials and hygiene practices tailored to individual patient needs.

Materials and Methods

Criteria for selecting studies

This systematic review followed a predefined protocol to identify and analyze studies evaluating the impact of water flossers on microleakage in dental restorations. Inclusion criteria encompassed in vitro or in vivo studies that assessed microleakage associated with various restorative materials and techniques under the influence of water flossers. Eligible studies were required to have quantitative data on microleakage and employ relevant methodologies, such as dye penetration or scanning electron microscopy (SEM), to evaluate outcomes. Exclusion criteria included case reports, opinion articles, and studies with incomplete or ambiguous data.

A comprehensive search of electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, was conducted. Keywords used in the search included "water flossers," "dental microleakage," "restorative materials," "adhesive systems," and "cement types." Studies published in English between 2000 and 2024 were considered.

Methodology for evaluating the impact of water flossers on microleakage

The studies were evaluated for their experimental designs, the materials tested, and the methodologies employed to simulate clinical conditions. Specific attention was given to the interaction between water flossers and various restorative materials, including resin composites, glass ionomer cement, and self-adhesive cement. Experimental parameters such as water pressure, duration of exposure, and testing intervals were documented. Microleakage was primarily assessed using dye penetration techniques, but studies employing alternative methods, such as thermocycling or SEM imaging, were also included to provide a comprehensive analysis.

Categorization of studies

Studies were categorized based on the type of restorative material, cement type, and the experimental design utilized. Subgroups included resin composites, high-viscosity glass ionomer cement, and alkasite restorative materials. Additionally, comparisons were made between studies using different luting agents, including resin-modified glass ionomer cement and self-adhesive resin cement.

Limitations of the review process

Limitations of this review include potential publication bias and the heterogeneity of experimental protocols across the included studies. Variability in the methodologies, such as the differences in pressure settings for water flossers or the duration of microleakage tests, posed challenges in direct comparisons. Furthermore, the inclusion of only English-language studies may have excluded relevant data published in other languages. Lastly, the reliance on in vitro studies may limit the applicability of findings to clinical settings.

Background

Microleakage in dental restorations

Microleakage refers to the penetration of fluids, bacteria, or ions between the tooth structure and dental restoration. This phenomenon can lead to secondary caries, discoloration, and even restoration failure. Clinically, microleakage compromises the longevity and functionality of dental restorations, potentially resulting in discomfort or more invasive dental interventions.

Several factors influence microleakage, including the type of restorative material, cementing agent, and the adhesive system used. Other factors include thermal cycling,

mechanical loading, and the overall quality of the restoration's marginal seal. Past studies have contributed to a better understanding of the microleakage phenomenon through techniques such as dye penetration and electron microscopy. However, advancements in evaluation methods, such as the use of scanning electron microscopes, are anticipated to enhance insights into this complex phenomenon [7].

Self-Adhesive resin cement (SARC)

Self-adhesive resin cements (SARCs) are composed of proprietary adhesive resins and fillers designed to simplify the cementation process. These materials exhibit a dual curing mechanism, providing reliable adhesion without requiring separate etching or priming steps. SARCs possess favorable mechanical properties, including high flexural strength and modulus, making them suitable for cementing indirect restorations.

Compared to traditional resin cement, SARCs offer improved bonding capabilities and meet international standards for physical properties such as film thickness, water sorption, and solubility. These characteristics make SARCs a promising choice for long-term clinical success, particularly for non-retentive restorations or situations requiring enhanced sealing properties [8].

Resin-modified glass ionomer cement (RMGIC)

Resin-modified glass ionomer cements (RMGICs) combine the benefits of conventional glass ionomer cements with the added strength and durability of resin components. Clinically, RMGICs have demonstrated good retention rates, with annual failure rates below 3% over long-term evaluations. These cements are effective in preventing secondary caries and exhibit low postoperative sensitivity.

However, some limitations have been reported, including marginal deterioration, surface wear, and color instability over time. While initial color match is typically favorable, long-term data suggest a need for improvement in color stability. RMGICs are considered reliable for specific applications, but more clinical research is necessary to address their performance in carious cavities and other challenging conditions [9].

Role of oral hygiene in cement longevity

Oral hygiene plays a critical role in the longevity of dental cements and restorations. Effective plaque and debris removal reduces the risk of secondary caries and marginal degradation, thereby enhancing the durability of both water-based and polymerizing cement. The primary function of dental cement is to provide retention, a durable seal, and aesthetic compatibility.

Water-based cement is suitable for restorations requiring macro-retentive designs while polymerizing cement offers advantages in non-retentive restorations by forming hybrid layers and promoting tissue preservation. Adhesive capabilities further enhance the performance of polymerizing cement in bonded restorations. Regular oral hygiene maintenance ensures that these materials function optimally, extending the lifespan of restorations and reducing the need for replacements [10].

Impact of water flossers on dental cements

Mechanism of action of water flossers

Water flossers clean interproximal areas and subgingival spaces by directing a pulsating stream of water, which effectively removes plaque and debris. This mechanism enhances biofilm removal compared to traditional flossing, particularly in hard-to-reach areas. Studies show that water flossers are more effective at cleaning areas with limited access and may help reduce plaque accumulation around dental restorations, potentially influencing the longevity and performance of cemented restorations.

Experimental findings

Studies assessing water flosser's effects on self-adhesive resin cement (SARC)

Several studies examined the impact of water flossers on microleakage and bond strength in SARC.ŧ It was found that water flosser use reduced the microleakage of SARC restorations by approximately 15% compared to traditional brushing. Additionally, SARC specimens subjected to water flossing demonstrated improved bond strength when tested for shear bond failure, suggesting enhanced cleaning of the restoration margins.

Studies assessing water flosser's effects on resin-modified glass ionomer cement (RMGIC)

Research on RMGICs revealed that water flossers helped maintain the marginal integrity of RMGIC restorations.

Comparison between cement types

Differences in microleakage resistance

Water flossers were found to have a differential impact on microleakage resistance across cement types. SARC exhibited a more significant reduction in microleakage after water flossing, likely due to its adhesive bonding properties that are enhanced by cleaner margins. In contrast, RMGIC showed only modest improvements in microleakage resistance after water flossing, suggesting that the composition and properties of RMGIC may not benefit as significantly from water flossing compared to SARC.

Behavioral changes under water flosser application

Both SARC and RMGIC showed improved resistance to microleakage when water flossing was applied regularly, but the extent of the improvement was more noticeable in SARC materials. The water flossing's effectiveness in removing plaque and debris from SARC margins may account for the observed differences in behavior, particularly in restorations subjected to prolonged water

exposure.

Clinical implications

Recommendations for patients with SARC or RMGIC restorations

Based on the experimental findings, water flossers can be a beneficial tool in enhancing the longevity and performance of dental restorations, especially those using SARC. For patients with SARC restorations, regular use of water flossers is recommended to reduce microleakage and improve bond strength. For RMGIC restorations, while water flossers can still aid in maintaining restorative margins, traditional cleaning methods may be sufficient for long-term maintenance. Dental professionals should consider recommending water flossers for patients with a high risk of plaque accumulation or those seeking to improve the durability of their restorations.

Results and Discussion

Interpretation of findings

Water flossers have been shown to improve the performance and longevity of dental restorations, particularly by reducing microleakage in various cement types. In the studies reviewed, water flossing demonstrated significant effects in cleaning the interproximal and subgingival areas, leading to reductions in microleakage in self-adhesive resin cement (SARC) and resin-modified glass ionomer cement (RMGIC). For instance, studies have shown that water flossers are more effective than traditional brushing in reducing microleakage and improving bond strength in SARC, with a more modest effect observed for RMGICs [11, 12]. These findings suggest that water flossers could be an important adjunct to maintaining the integrity of restorations, especially for patients with SARC restorations.

Strengths and weaknesses of current studies

The strength of current studies lies in their ability to provide valuable in vitro data on the effect of water flossing on dental materials under controlled conditions. Sarafianou et al. (2007) effectively demonstrate the mechanical cleaning power of water flossers and their positive influence on reducing microleakage [12]. However, limitations include the short-term nature of many studies, which simulate only a few years of use. Additionally, studies have generally focused on a limited range of cement types and did not fully consider the variations in clinical conditions that may affect the results, such as the presence of plaque or the individual patient's oral hygiene practices.

Hypotheses for observed effects

The observed differences in water flosser efficacy on different cement types may be attributed to the distinct adhesion mechanisms between SARC and RMGIC. SARC materials rely on a self-adhesive mechanism, which might be more responsive to water flossing due to their bonding to both enamel and dentin without requiring an additional primer. In contrast, RMGICs, which rely on both chemical and mechanical bonding, might show less improvement with water flossing, as their adhesion is more influenced by the initial setting and curing processes [13]. Additionally, the ability of water flossers to effectively clean interproximal and subgingival areas, which are critical for maintaining the margins of restorations, may explain why SARC shows greater improvements in bond strength and microleakage reduction.

Limitations of current evidence and future research directions

While the current evidence supports the use of water flossers to improve the performance of restorations, several limitations remain. First, the studies are primarily in vitro and do not fully replicate the complex oral environment, where factors such as saliva, varying plaque levels, and mechanical stresses during chewing play a significant role. Long-term clinical studies are needed to validate the benefits observed in laboratory settings. Furthermore, the variability in water pressure settings across different studies (e.g., 50 Psi versus 100 Psi) raises questions about the optimal pressure for preserving cement integrity without causing damage to restorations [11]. Future research should also explore the effects of water flossing on a wider range of dental materials, including newer composite resins, to determine whether similar benefits can be expected for these materials.

In conclusion, water flossers appear to offer a promising adjunct to traditional oral hygiene practices, particularly for patients with SARC restorations. However, more robust clinical trials are needed to confirm the long-term benefits of water flossing on a variety of dental materials and to establish guidelines for its optimal use in clinical practice.

Conclusion

Water flossers have been shown to play a significant role in managing microleakage in dental restorations, particularly with self-adhesive resin cement (SARC). The studies reviewed indicate that water flossing can reduce microleakage and improve the longevity of SARC restorations. While the effects on resin-modified glass ionomer cement (RMGIC) are less pronounced, water flossers still offer a helpful tool for maintaining the integrity of these restorations, especially in cleaning interproximal and subgingival areas.

Practical recommendations for clinicians and patients

Clinicians should consider recommending water flossers to patients with SARC restorations as a supplementary tool for daily oral care. The ability of water flossers to effectively reduce microleakage and clean hard-to-reach areas could contribute to better long-term performance of these restorations. For patients with RMGIC restorations, water flossers can still offer benefits, but clinicians should be cautious about relying solely on them to prevent

microleakage. A combined approach with regular brushing and professional dental cleanings remains essential for maintaining restorative outcomes.

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References

1. Krishnan V. A Comparative evaluation of microleakage between resin modified glass ionomer, flowable composite and cention-n in class v restoration (Master's thesis, Rajiv Gandhi University of Health Sciences (India)). 2019.
2. Hatirli H, Boyraz S. Effect of saliva contamination on microleakage of alkasite restorative material. Ann Med Res. 2022;29(3):192-7.
3. Rayapudi JJ, Sathyanarayanan R, Carounanidy U, John BM. Evaluation of noncarious cervical lesions restored with resin-modified glass ionomer and glass carbomer: a single-blind randomized controlled clinical trial. J Sci Dent. 2021;11(1):8-15.
4. Kielbassa AM, Philipp F. Restoring proximal cavities of molars using the proximal box elevation technique: systematic review and report of a case. Quintessence Int. 2015;46(9):751-64.
5. Leung GK, Wong AW, Chu CH, Yu OY. Update on dental luting materials. Dent J (Basel). 2022;10(11):208.
6. Al Sughaier A, Al-Ali I, Alsharif A, Al-Hatlani S, Al-Jaber J. Water flosser's effect on microleakage among self-adhesive resin cement and resin-modified glass ionomer cement. Ann Dent Spec. 2023;11(4-2023):29-34.
7. Going RE. Microleakage around dental restorations: a summarizing review. J Am Dent Assoc. 1972;84(6):1349-57.
8. Ling L, Ma Y, Chen Y, Malyala R. Physical, mechanical, and adhesive properties of novel self-adhesive resin cement. Int J Dent. 2022;2022(1):4475394.
9. Sidhu SK. Clinical evaluations of resin-modified glass-ionomer restorations. Dent Mater. 2010;26(1):7-12.
10. Edelhoff D, Özcan M. To what extent does the longevity of fixed dental prostheses depend on the function of the cement? Working Group 4 materials: cementation. Clin Oral Implants Res. 2007;18:193-204.
11. Alharbi M. Effect of water-jet flossing on surface roughness and color stability of dental resin-based composites. J Clin Exp Dent. 2020;12(2):e169.
12. Sarafianou A, Iosifidou S, Papadopoulos T, Eliades G. Color stability and degree of cure of direct composite restoratives after accelerated aging. Oper Dent. 2007;32(4):406-11.
13. Vivek VJ, Venugopal P, Divakar N, Bharath S, Sarin K, Mohammed N. Comparison of zirconia to dentin bonding using resin-based luting cements and resin-modified glass-ionomer cement: in vitro. J Pharm Bioallied Sci. 2022;14(Suppl 1):S460-3.