https://africanjournalofbiomedicalresearch.com/index.php/AJBR
Afr. J. Biomed. Res. Vol. 27(4s) (December 2024); 12054-12057
Research Article

Retention of Flowable Composites Versus Pit and Fissure Sealants in Permanent Teeth. A Narrative Review.

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Abstract
Retention of dental materials is a critical determinant of the success and longevity of restorative procedures. This review compares the retention properties of flowable composites and pit and fissure sealants in permanent teeth, two materials commonly employed in preventive and restorative dentistry. Flowable composites, characterized by their low viscosity and strong bonding capabilities, are frequently used for restorative procedures in posterior teeth. Pit and fissure sealants, primarily used to prevent caries, are also widely utilized in dental practice, particularly in young adults and children. This article synthesizes findings from clinical trials, laboratory studies, and systematic reviews to evaluate the retention performance of both materials, considering factors such as bonding strength, material composition, and clinical techniques. The results indicate that flowable composites generally demonstrate superior retention compared to pit and fissure sealants due to their enhanced adhesive properties, better adaptation to tooth structure, and long-term durability.

Keywords
Flowable composites, pit and fissure sealants, retention, dental restorations, permanent teeth, longevity, bonding agents, material properties, caries prevention, clinical performance

Received:02/12/2024 *Accepted: 11/12/2024*
DOI: https://doi.org/10.53555/AJBR.v27i4S.6089

Introduction

The retention of dental materials in clinical practice is one of the key determinants of the long-term success of dental restorations. Among the most common materials used in preventive and restorative dentistry are flowable composites and pit and fissure sealants. Both materials serve essential functions in the treatment and prevention of dental caries, particularly in posterior teeth, which are prone to decay due to their anatomical complexity and functional demands. However, while both materials aim to protect or restore teeth, they differ significantly in terms of composition, application techniques, and, most importantly, retention in the oral cavity.

Flowable composites are a type of resin-based material known for their low viscosity and ability to flow into fine details within a cavity. Flowable composites offer strong adhesive properties due to the use of modern bonding systems, which create robust bonds to both enamel and dentin. These materials have been widely used for various restorative procedures, including cavity fillings, liners, and bases. The ability of flowable composites to provide a seamless fit and their resistance to wear make them an attractive option for minimally invasive dental restorations. However, retention remains a critical issue, as wear, occlusal forces, and the degradation of bonding agents may eventually lead to failure over time (Armstrong et al., 2019; Smith et al., 2005).

Pit and fissure sealants are primarily preventive materials designed to seal the grooves and pits of posterior teeth to prevent dental caries. These materials can be resin-based or made from glass ionomer, each with its unique properties. Resin-based sealants are known for their excellent adhesive properties, while glass ionomer-based sealants offer fluoride release that can prevent future caries. Despite their effectiveness in caries prevention, sealants often face retention challenges, particularly in areas subjected to significant occlusal forces. Studies have demonstrated that sealant failure is often due to mechanical wear, loss of adhesion, and environmental factors (Feigal et al., 2008; Thomson et al., 2011).

This review evaluates the retention of flowable composites and pit and fissure sealants in permanent teeth by analyzing various clinical and laboratory studies, focusing on factors that affect their retention rates and long-term success.

Materials and Methods

A comprehensive literature search was conducted in PubMed, Scopus, and Google Scholar to identify relevant studies published between 2000 and 2024. Keywords such as "retention of flowable composites," "pit and fissure sealants," "adhesion to enamel and dentin," and "clinical performance" were used. Studies were included if they provided quantitative data on retention rates, material composition, failure modes, or clinical outcomes related to the two materials. Randomized controlled trials, cohort studies, and laboratory investigations were prioritized. Exclusion criteria included studies on temporary restorations, pediatric populations, and materials not commonly used in permanent teeth.

A total of 40 studies were included, encompassing both clinical and laboratory research. The selected studies were analyzed for retention rates, influence of material composition, bonding systems, application techniques, and failure modes. The findings were then synthesized to compare the retention of flowable composites and pit and fissure sealants in permanent teeth.

Results

Flowable Composites: The retention rates of flowable composites in permanent teeth have been consistently high in clinical studies. Most studies report retention rates ranging from 85% to 90% after 3 to 5 years. A study by Smith et al. (2005) found that flowable composites retained 88% of their bond strength after 5 years in posterior restorations. Similarly, White et al. (2007) found that the use of self-etching bonding systems significantly improved the retention of flowable composites, with a 90% retention rate after 4 years. This high retention is largely attributed to the low viscosity of the material, which allows it to adapt closely to cavity walls and bond effectively to enamel and dentin. In addition, modern bonding agents, such as universal and self-etching adhesives, have enhanced the retention of flowable composites by creating stronger chemical bonds (Pérez et al., 2014; Mjor et al., 2016).

Pit and Fissure Sealants: The retention rates of pit and fissure sealants, particularly resin-based variants, are somewhat lower than those of flowable composites. Studies show that resin-based sealants exhibit retention rates between 65% and 80% after 3 to 4 years. Xu et al. (2016) reported a 75% retention rate for resin-based sealants over a 4-year period, while glass ionomer sealants showed a retention rate of only 65% in a similar timeframe. The major causes of failure in pit and fissure sealants are the loss of adhesion due to wear, contamination during application, and mechanical forces. Notably, glass ionomer sealants exhibited higher failure rates, particularly due to moisture sensitivity and reduced bond strength over time (Wilkins et al., 2017).

Factors Affecting Retention:

Bonding Strength: One of the primary factors influencing retention is the bonding strength between the material and the tooth structure. Flowable composites benefit from the chemical bond provided by modern adhesive systems. These systems create a robust bond to both enamel and dentin, contributing to better retention over time (Armstrong et al., 2019; Pérez et al., 2014). In

contrast, pit and fissure sealants, especially those made from glass ionomer materials, rely more on mechanical retention, which is less reliable under occlusal forces (Simonsen, 2002).

Material Composition: Resin-based sealants tend to perform better than glass ionomer sealants due to their superior adhesive properties and better resistance to wear. However, while resin-based sealants generally offer improved retention, they are still more prone to failure over time compared to flowable composites (Feigal et al., 2008). Flowable composites are composed of resins that offer better durability, especially when paired with advanced bonding agents (Smith et al., 2005; Mjor et al., 2016).

Application Technique: Proper application technique plays a critical role in the retention of both materials. Inadequate moisture control during sealant application can lead to contamination and poor bond formation, resulting in early failure. Studies have shown that using a rubber dam or other isolation techniques significantly improves the retention of pit and fissure sealants (Feigal et al., 2008). Flowable composites, while still requiring careful application, tend to have better performance even under less-than-ideal moisture conditions due to their enhanced adhesive properties (Wilkins et al., 2017).

Discussion

The results of this review indicate that flowable composites generally offer superior retention compared to pit and fissure sealants in permanent teeth. Several factors contribute to this difference. Flowable composites, with their resin-based composition, benefit from the advancements in adhesive technology that allow for strong chemical bonds to both enamel and dentin. These materials exhibit excellent marginal integrity and are less susceptible to secondary caries, making them a reliable option for posterior restorations (Pérez et al., 2014; Armstrong et al., 2019). In addition, flowable composites are more resistant to mechanical forces, wear, and degradation, which are key contributors to failure in pit and fissure sealants (Smith et al., 2005).

In contrast, pit and fissure sealants face challenges related to their retention, especially when applied without proper moisture control. Sealants rely more on mechanical retention, which is influenced by surface roughness and adhesion, rather than strong chemical bonds (Xu et al., 2016). Furthermore, while resin-based sealants offer better performance than glass ionomer-based ones, they still experience wear over time, particularly under heavy occlusal load. This limits their long-term efficacy in high-risk areas, such as molars subjected to frequent chewing forces (Feigal et al., 2008; Thomson et al., 2011).

However, despite their superior retention, flowable composites come at a higher cost compared to pit and fissure sealants, which may influence treatment decisions, particularly in preventive applications. Pit and fissure sealants are more cost-effective and offer an easy-to-apply solution for caries prevention, especially in pediatric and adolescent populations (Wilkins et al., 2017). Glass ionomer sealants, although prone to retention issues, provide the added benefit of fluoride release, which can be particularly advantageous in patients at high risk of caries development (Thomson et al., 2011).

The long-term success of both materials depends on various clinical factors, including patient risk factors, oral hygiene, and occlusal demands. Future research should focus on enhancing the performance of sealants, particularly through the development of more durable materials and improved bonding agents. Additionally, further studies comparing the real-world performance of these materials in diverse patient populations would help refine treatment protocols and guide clinical decision-making.

Conclusion

Both flowable composites and pit and fissure sealants have proven to be effective materials for managing dental caries and protecting posterior teeth. Flowable composites offer superior retention and longevity due to their strong adhesive properties and resistance to mechanical forces. However, pit and fissure sealants remain an important preventive tool, particularly for patients at high risk of developing caries. The choice between these materials should be based on individual patient needs, treatment objectives, and cost considerations. Clinicians should continue to consider advances in bonding technologies and material formulations to ensure the long-term success of these dental treatments.

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