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Review Article

Comparative analysis of different filling materials in deciduous teeth

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ABSTRACT

Dental caries in pediatric patients presents a significant challenge in maintaining oral health, making the choice of filling materials for deciduous teeth crucial for long-term success. Various restorative materials, including composite resins, glass ionomer cements (GICs), and resin-modified glass ionomers (RMGICs), have been used, each with distinct properties regarding durability, biocompatibility, and aesthetic outcomes. Composite resins are well-regarded for their ability to closely match the natural color of teeth, making them ideal for anterior restorations. However, they are technique-sensitive and may not provide sufficient durability in posterior regions subjected to high stress. Glass ionomer cements, known for their ease of placement and fluoride release, offer functional benefits in high-caries-risk patients, despite their lower aesthetic quality and susceptibility to wear over time. Resin-modified glass ionomers attempt to combine the strengths of both composites and GICs by improving durability and aesthetics while maintaining the fluoride-releasing property. The safety and biocompatibility of these materials also play a pivotal role in pediatric dentistry. While composite resins may release small amounts of bisphenol A (BPA), which has raised concerns about its potential health risks, GICs and RMGICs are generally considered safer due to their simpler chemical composition and fluoride release. In terms of functional longevity, composite resins offer better wear resistance compared to GICs, though resin-modified glass ionomers provide a compromise with improved strength and ease of use. Ultimately, the choice of restorative material should consider the specific clinical circumstances, including the child's caries risk, tooth location, and the balance between aesthetic and functional needs. No single material is universally ideal for all cases, and a tailored approach is necessary to optimize outcomes in pediatric dental restorations.

Keywords: Composite resins, Glass ionomer cements, Resin-modified glass ionomers, Pediatric dentistry, Deciduous teeth restoration

INTRODUCTION

Dental caries is one of the most prevalent oral health problems in children, and it remains a significant public health concern globally. In primary teeth, or deciduous teeth, early and appropriate intervention is critical to prevent infection, pain, and premature tooth loss, all of which can negatively affect a child's oral and overall health. Restorative dentistry in pediatric patients plays a crucial role in maintaining the integrity and function of the primary dentition until the natural exfoliation process occurs. A key aspect of this is the selection of appropriate filling materials, which can have long-term implications for both oral health and the comfort of the young patient.

Historically, amalgam has been the most commonly used material for dental restorations, including in deciduous teeth, due to its durability and ease of application. However, concerns about aesthetics and the potential toxicity of mercury in amalgam have driven the development and preference for alternative materials.[1] Today, various filling materials are available for restoring decayed deciduous teeth, including composite resins, glass ionomer cements (GICs), and resin-modified glass ionomers (RMGICs). Each of these materials has distinct properties regarding strength, durability, biocompatibility, and ease of use, which must be carefully considered in pediatric dental care. Composite resins are frequently used for their superior aesthetic properties, as they can be closely matched to the color of natural teeth. However, they require a dry field and technique-sensitive placement, which may be challenging in young children.[2] Glass ionomer cements, in contrast, offer ease of use, especially in situations where moisture control is difficult, and they have the added benefit of fluoride release, which can aid in caries prevention.[3] Nonetheless, GICs tend to be less durable than composites and may not be suitable for high-stress areas of the dentition.

The ongoing evolution of dental materials has led to the development of resin-modified glass ionomers, which attempt to combine the advantages of both composites and GICs. These materials offer improved strength and aesthetics compared to traditional GICs while maintaining the fluoride release and ease of use in pediatric patients.[4] Despite these advancements, there remains debate regarding the optimal filling material for use in deciduous teeth, particularly in terms of long-term outcomes and biocompatibility. This review aims to provide a comparative analysis of different filling materials used in deciduous teeth, focusing on their durability, biocompatibility, and aesthetic outcomes.

REVIEW

The analysis of different filling materials in deciduous teeth reveals significant variations in performance, durability, and clinical outcomes. Composite resins, for instance, are lauded for their aesthetic appeal, as they blend seamlessly with the natural tooth color, offering high patient satisfaction. However, their technique sensitivity, particularly in maintaining a dry field during placement, poses a challenge in pediatric dentistry. Additionally, composites are more prone to marginal leakage, which can increase the risk of secondary caries.[5] In contrast, GICs are favored for their ease of use in young patients, particularly in situations where moisture control is difficult. GICs also release fluoride, which contributes to their anti-cariogenic properties, making them an attractive option for children prone to caries.[6]

Despite these advantages, GICs are less durable and more prone to wear and fracture compared to composites, which limits their use in areas of high occlusal stress. The development of RMGICs has addressed some of these limitations, offering improved strength and aesthetics while maintaining the fluoride release benefits of GICs. However, the long-term clinical success of RMGICs, particularly in high-stress areas, remains under investigation.[5] In conclusion, while no single material is universally superior, the choice of filling material should be tailored to the individual needs of the pediatric patient, considering factors such as caries risk, age, and the tooth's functional demands.

Longevity and durability of different filling materials

The longevity and durability of restorative materials in deciduous teeth are essential considerations in pediatric dentistry, as premature failure can lead to additional treatments and discomfort for young patients. Among the commonly used materials, composite resins, GICs and RMGICs each have varying strengths and weaknesses in terms of durability. Composite resins are often favored for their aesthetic properties and relative strength. When placed correctly, they can last for several years, with studies indicating a survival rate of 80-90% over a three-year period in primary teeth.[7] However, their success depends largely on the technique used and the ability to maintain a dry field during placement. Moisture contamination during the bonding process can compromise the bond strength, leading to marginal breakdown and eventual failure. Additionally, composites are susceptible to wear and fractures in areas of high occlusal stress, especially in the molars of young patients.[8]

Glass ionomer cement, on the other hand, offer a distinct advantage due to their chemical adhesion to both enamel and dentin, which enhances their longevity in conditions where mechanical retention is difficult to achieve. Their ability to release fluoride over time provides added protection against secondary caries, making them particularly useful in high-caries-risk patients.[9] Despite these benefits, GICs tend to exhibit lower fracture resistance and are more prone to wear, especially in areas subjected to high chewing forces. This limitation affects their long-term durability, with many GIC restorations showing signs of wear within two to three years, necessitating repair or replacement.

RMGICs were developed to improve upon the weaknesses of conventional GICs. These materials offer increased strength and resistance to wear compared to traditional GICs, making them more suitable for restorations in load-bearing areas. RMGICs retain the fluoride-releasing properties of GICs, contributing to their long-term anti-cariogenic effect, while also being less technique-sensitive than composite resins. However, despite these improvements, studies indicate that RMGICs may still not match the longevity of composite resins in high-stress areas, though they outperform GICs.[2,9] The longevity and durability of filling materials in deciduous teeth depend on multiple factors, including the material's inherent properties and the clinical scenario in which it is used. While composite resins provide superior durability, GICs

and RMGICs offer unique benefits in terms of ease of use and caries prevention, making them valuable in specific clinical situations.

Biocompatibility and safety of filling materials in pediatric dentistry

The biocompatibility and safety of dental materials are of paramount importance, particularly in pediatric dentistry, where young patients are more sensitive to toxic or irritating substances. When selecting a filling material for deciduous teeth, it is critical to assess not only its physical properties but also its biological interaction with the surrounding tissues. Various restorative materials, including composite resins, GICs and RMGICs, differ significantly in their biocompatibility and potential health risks.

Composite resins, although widely used for their aesthetic appeal, have raised concerns about the release of certain components, such as bisphenol A (BPA), during polymerization. BPA is a known endocrine disruptor, and its release has been a subject of debate regarding its potential impact on children's health.[10] While studies suggest that the amount of BPA released is minimal and unlikely to cause significant harm, it is essential for clinicians to be aware of this risk, particularly in pediatric populations. Furthermore, composites require the use of bonding agents, some of which contain potentially cytotoxic components, though advancements in bonding technology have led to the development of safer formulations.[11]

Glass ionomer cements, by contrast, are often considered safer due to their more straightforward chemical composition and ability to chemically bond to the tooth structure without the need for potentially harmful bonding agents. GICs have excellent biocompatibility and are less likely to cause an adverse reaction in the pulp or surrounding tissues. In addition, GICs have been shown to have a positive effect on the local oral environment due to their continuous release of fluoride, which can promote re-mineralization and provide a long-term anti-cariogenic effect.[12] This feature makes them a valuable choice in high-caries-risk pediatric patients, reducing the need for more invasive treatments later on.

RMGICs offer a compromise between the aesthetics and strength of composites and the biocompatibility of GICs. Although RMGICs contain some resin components, they generally release lower levels of potentially harmful substances compared to composite resins. Studies indicate that the fluoride release from RMGICs contributes to their overall safety profile, helping to reduce the risk of secondary caries and promote tooth health.[12] However, as with composites, clinicians must be cautious of any potential allergenic reactions to the resin component, though such cases are rare. The biocompatibility and safety of restorative materials in pediatric dentistry are critical factors in material selection. While composite resins offer aesthetic advantages, GICs and RMGICs are often considered safer due to their chemical composition and fluoride-releasing properties, making them more suitable for certain pediatric patients.

Aesthetic and functional outcomes in restorations of deciduous teeth

Aesthetic and functional outcomes are critical factors in the selection of restorative materials for deciduous teeth, as they influence not only the immediate success of the restoration but also the long-term oral health and psychological well-being of the pediatric patient. Parents and children alike are often concerned with the appearance of dental restorations, making aesthetics an important consideration, while dentists focus on maintaining the functionality and structural integrity of the restored tooth. Different restorative materials, including composite resins, GICs and RMGICs, vary in their ability to meet these aesthetic and functional demands.

Composite resins are often regarded as the gold standard for aesthetic restorations due to their superior color-matching capabilities. These materials can be closely adapted to the natural color of the tooth, providing a nearly invisible restoration, which is especially important in anterior teeth. The high polishability of composite resins further enhances their aesthetic appeal, ensuring a smooth surface that mimics the natural tooth structure.[13] However, the aesthetic benefits of composites come with certain trade-offs in terms of functionality. Composite resins are technique-sensitive, and achieving an optimal bond in a pediatric patient can be challenging. Additionally, in high-stress areas like the posterior teeth, composites may wear down or fracture over time, compromising the functional integrity of the restoration.[14] In contrast, glass ionomer cements offer less favorable aesthetic outcomes due to their opaque appearance, which can be noticeable in anterior restorations. GICs are typically used in posterior teeth where aesthetics are less of a concern. However, the fluoride release from GICs contributes to their functional success, particularly in high-caries-risk patients, as it helps protect the restored tooth from further decay.[15] While GICs may not offer the same level of aesthetic satisfaction as composites, their functional benefits, such as ease of placement and fluoride release, make them a viable option for pediatric restorations.

RMGICs provide an intermediate solution, offering improved aesthetic outcomes compared to conventional GICs while retaining many of their functional advantages. RMGICs are less opaque and provide better color-matching capabilities than traditional GICs, although they still do not match the aesthetic appeal of composite resins.[13] Additionally, RMGICs combine the functional benefits of GICs, including fluoride release and ease of use, with enhanced wear resistance and durability, making them suitable for both aesthetic and functional restorations in deciduous teeth. The choice of restorative material for deciduous teeth involves balancing aesthetic desires with

functional requirements. Composite resins excel in aesthetic outcomes but may fall short in durability, particularly in high-stress areas. GICs and RMGICs offer functional advantages, such as fluoride release and ease of placement, though their aesthetic outcomes may be less favorable. Ultimately, the choice of material should be guided by the specific clinical situation and the needs of the pediatric patient.

CONCLUSION

The selection of filling materials for deciduous teeth should be based on a balance of aesthetic and functional considerations, as well as the clinical needs of the pediatric patient. While composite resins offer superior aesthetics, their technique sensitivity and wear resistance may be limiting in certain cases. Glass ionomer cement and resin-modified glass ionomers provide functional advantages, particularly in high-caries-risk patients, though they may not match the aesthetic qualities of composites. Ultimately, the optimal choice of material depends on individual patient factors, including caries risk, tooth location, and restorative needs.

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