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"Esthetic Restorative Materials in Pediatric Dentistry"- A Comprehensive Review

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Abstract:
Pediatric dentistry has witnessed a paradigm shift from purely functional restorations to those that combine function with superior esthetics. The demand for esthetic restorations in children has increased with growing parental awareness, evolving materials, and minimally invasive techniques. This article reviews the commonly used esthetic restorative materials in pediatric dentistry, their properties, clinical applications, advantages, and limitations, providing evidence-based insights into current trends and future directions.

I. Introduction:

The management of carious or traumatized primary and young permanent teeth has evolved significantly in recent decades. Traditionally, dental amalgam and stainless steel crowns (SSCs) were widely used because of their longevity and cost-effectiveness. However, concerns about mercury, metallic appearance, and increased esthetic expectations from parents and children have led to the development and widespread use of esthetic restorative materials.

Esthetics is a branch of philosophy dealing with the nature of beauty, art and taste, and with the creation and appreciation of beauty. It is more scientifically defined as the study of sensory or sensory-emotional values, sometimes called judgments of sentiment and taste. More broadly, scholars of the field define aesthetics as "critical reflection on art, culture, and nature[1].

The key to a successful dental restoration lies in the careful selection of a dental material which is appropriate for the intended procedure. Esthetic materials were developed for permanent teeth restorations, but they can also be successfully used for thetreatment of primary dentition, especially in minimal intervention, atraumatic tooth restoration, and preventive interventions.

Like it or not, we live in a beauty conscious society. In fact, since the turn of the century, the American advertising community has pushed the idea that "beautiful is better". However, not all beautiful people are born that way. Fortunately, such self improvement is no longer the exclusive domain of rich and famous. Nor is it considered as a sign of self indulgence or vanity. Quite the contrary, taking steps to improve your appearance today is considered as an investment in health and well being, and it is as socially acceptable as it is personally gratifying[2].

Many esthetic restorative materials are available. They are direct and indirect filling esthetic restorative materials. Indirect filling esthetic restorative materials like fused porcelain, ceramics, indirect composites are not used in primary dentition. Direct filling esthetic restorative materials are silicate cements, acrylic resins, composite resins and glass ionomer cements. Some of these materials like silicate cements and acrylic resins are not used at present because of their disadvantages.[3]

The concepts of esthetic dentistry and tooth colored restorations are not new and their demand has been increasing day by day. And it is for this reason that there have been continuous attempts by researchers to find the ideal esthetic restorative material with best mechanical, physical, biological properties, though no single material fulfills all ideal requirements.

The purpose of this dissertation is to provide an insight to two esthetic materials, i.e. composite resins and glass ionomer cements used for restorative dentistry in children and adolescents. The latest innovations of these esthetic dental materials will be described and illustrated. The clinical techniques of these materials will be discussed in detail with special emphasis on their implications in pediatric and adolescent dentistry. This review highlights the current evidence and clinical performance of esthetic restorative materials used in pediatric dentistry.

Esthetic Restorative Materials: Overview

1. Resin-Modified Glass Ionomer Cements (RMGICs):[4,5,6]

Hybrid of glass ionomer cement and resin, offering chemical adhesion and fluoride release.
Advantages:
Good esthetics compared to conventional GICs
Improved strength and polishability
Fluoride release and recharge potential

Limitations:
Lower wear resistance than composites

Moisture sensitivity during placement

Indications:
Class V restorations

Interim restorations in primary teeth

Cervical carious lesions

2. Compomers (Polyacid-modified composite resins):[7,8,9]

Combination of composite resin with glass ionomer technology.

Advantages:

Better esthetics and handling than GICs

Fluoride release and bonding to enamel and dentin

Suitable for primary teeth due to ease of placement

Limitations:

Lower wear resistance than composites

Limited fluoride recharge compared to RMGIC

Indications:

Class I and II restorations in primary molars

Preventive resin restorations

3. Composite Resins[10,11]
Resin matrix with filler particles, available in micro hybrid, nanohybrid, and bulk-fill formulations.

Advantages:
Excellent esthetics, polishability, and color match

High strength and wear resistance

Versatile in anterior and posterior teeth

Limitations:
Technique sensitive; requires proper isolation

Polymerization shrinkage can lead to marginal leakage

Indications:
Anterior restorations (fractured incisors)

Posterior Class I and II restorations with proper isolation

Strip crowns for primary anterior teeth

4. Preformed Esthetic Crowns (Zirconia Crowns)

High-strength yttria-stabilized zirconia.

Advantages:

Superior esthetics and natural appearance

High fracture resistance

Biocompatibility and plaque resistance

Limitations:

Requires significant tooth reduction compared to SSCs

Technique sensitive and costlier

Indications:

Full coverage for severely decayed or hypoplastic primary incisors and molars

Alternative to stainless steel crowns in esthetic zones

5. Strip Crowns

Technique: Clear celluloid forms filled with composite resin to restore severely decayed or fractured primary anterior teeth.

Advantages:

Excellent esthetics and minimal cost

Customizable shape and size

Limitations:

Technique sensitive

Risk of fracture and marginal discoloration over time

6**. GC Fuji IX GP**[12]

Indication:
Excellent intermediate restorative material

Long life provisional restorations

Permanent restorations in areas not exposed to stress bearing loads (excellent for cervical lesions in this patient population)
Core build-ups

7. Pink Glass Ionomer Cement (Fuji VII)[13,14]
Advantage
Free Flowing Consistency
Antibacterial Property
acute caries stabilization

8.Chlorhexidine Containing Glass Ionomer Cement:[15,16]
The ability to incorporate antibacterial compounds in dental restorative materials would provide many potential benefits to patients. An ideal system would:
(1) Eliminate the recurrence of decay around margins of restorations

(2) Inhibit plaque formation on and near restored surfaces, and

(3) Reduce the number of microorganisms in salivary fluids and the oral cavity[48]

9. ORMOCERS:[17,18]
(1) Biocompatibility: After the placement of the filling, ORMOCER will not release any detectable residual substances and is therefore biocompatible.
(2) Reduced polymerization shrinkage: The material is found to have polymerization shrinkage of about 1.88%.
(3) High abrasion resistance: Owing to its excellent abrasion resistance the material can be used in the posterior area that is exposed to masticatory load and ensure outstanding long-term stability of the filling in this area load bearing area.
(4) Lasting aesthetics: Unlike amalgam, ORMOCER is a tooth colored restorative material, which is available in twelve finely graduated shades. Due to their chemical-physical characteristics, these materials have long- term protection against discoloration.
(5) Anticariogenic property: It provides additional protection against dental decay. ORMOCER protects both the tooth structure itself by strengthening the tooth substance through permanent release of enamel hardening minerals like fluoride, calcium and phosphate ions that protect the adjoining cavity margins.
(6) Cost effective: Excellent price to performance ratio.

(7) Fast and safe handling: The innovative one-step bonding "Etch and Prime 3.0" with their water based bonding, the etching of the dental enamel with phosphoric acid gel otherwise required is not necessary, as well as the separate rinse and dry steps are redundant.

10. **CEROMERS** [19,20]
The term ceromer stands for Ceramic Optimized Polymer and was introduced by Ivoclar to describe their composite TetricCeram.

Uses:
- Ceromer can be used for veneers, inlay/onlay without a metal framework.
- Also can be used with Fiber Reinforced composite framework for inlays/onlay, crowns and bridges (3

units) and for crown and bridges including implant restorations on a metal framework.

- Ivoclar in cooperation with several universities has developed advanced polymer systems and ceramic fillers from which high performance Ceromers (ceramic optimized polymers) have been produced. These Ceromers combine the advantages of ceramics with those of state-of-the- art composites.

11. Recent Advances:
Bulk-fill composites enabling faster placement in posterior restorations.

Bioactive restorative materials that release calcium, phosphate, and fluoride to promote remineralization.

3D-printed crowns and CAD/CAM zirconia restorations enhancing customization and precision.

Modern pediatric restorative dentistry focuses on:
Biocompatibility
Fluoride release and remineralization
Minimal intervention
Longevity with enhanced esthetics

Clinical Considerations and Material Selection
The choice of restorative material depends on:

Child's age and cooperation level

Extent of caries and remaining tooth structure

Esthetic demands of parents and patient

Moisture control feasibility

Cost considerations

A common clinical approach involves combining materials—such as using RMGICs as a liner/base with composite overlays—to maximize the benefits of each material.

Ideal Requirements of Pediatric Restorative Materials

An ideal restorative material for children should:
✓ Be adhesive to tooth structure
✓ Provide fluoride release and caries inhibition
✓ Be easy to handle and place in challenging pediatric situations
✓ Have high wear resistance and durability
✓ Offer excellent esthetics and color stability
✓ Be cost-effective and minimally invasive

II. Discussion:

The selection of esthetic restorative materials in pediatric dentistry is influenced by a dynamic interplay of clinical, material, and patient-related factors. Unlike adult dentistry, pediatric cases demand materials that can withstand the unique challenges of primary teeth, such as thinner enamel, larger pulp chambers, and a higher risk of moisture contamination during procedures.[21]

1. Balance Between Esthetics and Functionality:

While composite resins and zirconia crowns offer unmatched esthetics, their clinical success depends on proper isolation and operator skill. On the other hand, materials like RMGICs and compomers, though slightly less esthetic, provide additional benefits such as fluoride release and chemical adhesion, which are particularly advantageous in high-caries-risk children. Thus, material selection should not be based solely on esthetics but should also consider the long-term preservation of tooth structure and caries prevention.

2.Handling Characteristic sand Child Cooperation:
Children often present with limited attention spans and reduced tolerance for lengthy procedures. This necessitates the use of materials with simplified application techniques and reduced chair-side time. RMGICs and bulk-fill composites align with these requirements due to their ease of placement and reduced incremental layering.

3.Longevity and Maintenance:
Although esthetic restorative materials have improved in strength and wear resistance, long-term studies indicate that restorations in primary teeth often require maintenance or replacement over time due to occlusal wear or secondary caries. Strip crowns, for example, are highly esthetic but may fracture or discolor after prolonged use. Zirconia crowns, though more durable, involve more aggressive tooth preparation, which should be weighed against their longevity.

4.Parental Expectations and Cost Considerations:
Parents today are more aware of dental esthetics and often request tooth-colored restorations even in posterior regions. However, cost can be a limiting factor, particularly for advanced options like preformed zirconia crowns. Clinicians must therefore balance parental expectations with realistic outcomes, discussing the pros and cons of each material prior to treatment.

5.Future Directions:
Emerging bioactive materials and nanotechnology-enhanced composites show promise in combining superior esthetics with remineralization properties. Further clinical trials are required to evaluate their long-term performance in the unique environment of pediatric dentistry.

III. Conclusion:

Esthetic restorative materials have revolutionized pediatric dentistry by allowing clinicians to restore function while meeting high esthetic expectations. The selection of material should be evidence-based, tailored to each clinical scenario, and balanced with factors such as child cooperation and long-term prognosis. Ongoing research into bioactive and minimally invasive materials promises an even brighter future for esthetic pediatric restorations.

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