ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 2 Issue 11 November 2018

Review Article

Dental Materials used in Pediatric Dentistry - A Sneak Peek

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Received: October 05, 2018; **Published:** October 22, 2018

Abstract

Dental caries is a highly prevalent disease of the world, which is the most common infectious disease in children. Caries risk is more in children from rural areas, poor and for those with ethnic background or who have less access to care. Restorative treatment should be based on the results of an appropriate clinical examination and must be an integral part of a comprehensive treatment plan.

Keywords: Advances; Composites; Dental Material; Glass Ionomer

Introduction

Caries is the most common chronic disease in children. It is more prevalent than asthma and common than hay fever. The traditional approach to treating caries is to place a dental restoration. In the past few years, many changes have been made in the development and availability of restorative materials for pediatric population. The pediatric dental practitioner is loaded with many materials from which to select according to each restorative situation [1]. The number of choices is plenty which allows extremely good final result, but it creates confusion in terms of how to differentiate the uses of these various materials There are many options available to paediatric dentists for restorative dentistry. There are numerous new classes of materials being added which makes it difficult to choose the correct materials. When choosing a treatment option for pediatric dental patient each patient and restorative material needs to be evaluated individually. This is to ensure appropriate care within each material's limits because each restorative material has its advantages and disadvantages.

The factors guiding the choice in pediatric restorations are

1. Age of the child'
2. Caries risk,
3. Cooperation of the child,
4. Type of the tooth and
5. Type of material.

Taking into account the restorative needs for children, one must consider several categorical objectives. The cavity should be sealed so that further tooth destruction does not happen, and it renders the tooth and tooth-restoration interface caries resistant, and the ease of use of the material in a clinical scenario should be included [2]. In addition, the material selected for the procedure must survive in the extreme environment of the mouth for the period in which it is placed to be effective.

Silver amalgam

Silver amalgam has been used for restoring teeth for more than 100 years and it is still used extensively in pediatric dentistry. Dental amalgam was first used in China and in Germany by Strockerus in 1528. Improvement of the properties and clinical handling of tooth color materials along with continuing concern over the toxicity of dental amalgam led to questioning the desirability of continued use of dental amalgam in children. The subject has been so widely investigated that the British Society of Paediatric Dentistry (BSPD) produced a policy document in 2001 to provide guidance on the use of amalgam in children's dentistry in the United Kingdom [3].

Present use of amalgam in primary molars

The daily practice of pediatric dentistry some 50 years ago did not have many choices concerning restorative materials. For primary molars, amalgam and stainless-steel crowns were mainly used, but sometimes cemented orthodontic bands were used as restorations. Presently, as are other dental practitioners, the pediatric dentist is confronted with many materials to select for each situation. The British Society of Paediatric Dentistry, analysing the use of amalgam in the United Kingdom and other European countries, observed that although there was no policy concerning the use of amalgam, most parents ask for esthetic alternatives.7 In Sweden, the original ban on amalgam use was for environmental reasons. Dentists are avoiding amalgam use in children and pregnant mothers. From July 1, 2018, dental amalgam was banned for use in dentistry in 28 countries for children under the age of 15 and for pregnant or nursing mothers. The Minamata Convention Treaty is an integral part of what inspired these 28 countries to ban mercury amalgam for these vulnerable communities [4].

Glass Ionomer cements

Glass-ionomer cements belong to the category falling as acid-base cements. They are formed by the reaction of weak acids with powdered glasses of basic nature. Setting occurs in water and the final structure contains a substantial amount of unreacted glass which acts as filler to reinforce the set cement. The term "glass-ionomer" was applied to them in the earliest publication but is not so correct. The proper name for them, according to the International Organization for Standardization, ISO, is "glass polyalkenoate cement", but the term "glass-ionomer" is recognised as an accepted name and is widely used in dental profession [5].

Recent Advancements [6]

- **a) Anhydrous:** In this modification the liquid is delivered in a freeze-dried form that is then incorporated into the powder. The liquid used is clean water only, and this enhances the shelf-life and facilitate mixing.
- **b) Resin - Modified:** These materials have a small quantity of a resin infiltrated into the liquid formula. Not more than 1% of photo initiators are allowed for the setting reaction which will be initiated by light of the correct wavelength.
- **c) Nano - Ionomer:** The Nano-Ionomer has great wear resistance, esthetics and polish ability compared to other glass ionomers, and also offers fluoride release similar to conventional and resin-modified glass ionomer.
- **d) Compomer:** This term was developed by the manufacturer to incorporate some properties of glass ionomer with a composite resin. A compomer is a composite resin which uses ionomer glass as the filler which is the major constituent of a glass ionomer.
- **e) Ceramic reinforced glass ionomer**: Ceramic reinforced glass ionomer exhibits stronger compressive, flexural and tensile strengths which are comparable to amalgam.
- f) Zirconomer-Recently, zirconia-reinforced GI (Zirconomer, Shofu Inc., Japan), a novel material, was introduced that could overcome the drawbacks of previously used tooth-colored restorative materials. It consists of zirconium oxide, glass powder, tartaric acid, polyacrylic acid, and deionized water as its liquid. Zirconomer® (White Amalgam) is developed to exhibit the strength, i.e., consistent with amalgam, through a rigorous manufacturing technique [5].
- g) Equia - Equia™, is a new glass ionomer restorative system, recently introduced by GC America. It is a mix of a self-adhesive highly filled glass ionomer and a self- adhesive filled resin surface sealant. The three systems are
  1) **Self-adhesive:** The Equia system can be used with or without a cavity conditioner. Use as a self-adhesive without the cavity conditioner makes it better for the establishment of a chemical bond.
  2) **Filled Glass Ionomer:** Fuji IX GP Extra is filled glass ionomer. The esthetics of the material is improved. Its high viscosity makes it better for handling and decreases wear resistance.
  3) **Sealant:** The sealant has multiple advantages. It fills the voids of the restoration and reduces the surface irregularities. Sealant application allows for the glass ionomer to cure chemically without desiccation and makes good for improved marginal integrity [7].

Composite resins

Composite (componere = to combine) is universally used as a tooth-coloured restorative material since long. Composites were developed by combining dimethacrylates with salinized quartz powder. Composites have taken over the place that was occupied by amalgam because of their excellent properties, namely, esthetics and adhesiveness. The material consists of three components: resin matrix, fillers and coupling agents [7,8].

Whats new?

Mainly three procedures

1. Simplify the restorative procedure (self-adhesive composites);
2. Reducing the risk of composite bulk fracture (fiber-reinforced and self-healing composites);
3. Défense mechanisms against new caries lesions at the tooth-restoration interface (remineralizing and antibacterial agents) [9,10].

Self-adhesive restorative composites (SACs) were introduced in 2009. These low-viscosity materials are indicated for small class I cavities and non-carious cervical lesions. Unfortunately, reports of *in vitro* evaluations of these materials are less and clinical studies are none. E.g.-Embrace wet bond, Vertise flow.

Fiber-reinforced composites- The incorporation of small fractions of glass fibers as part of the filler system is one of the strategies to create tougher composites currently.

Self-healing composites- The development of self-healing polymers was a major breakthrough. Research in dental composites self-repair systems derives from the approach introduced recently. The combining of dicyclopentadiene (DCPD) -filled microcapsules with a urea-formaldehyde (UF) shell and dispersed them an epoxy matrix. When the crack front reached a microcapsule, its shell was ruptured and DCPD was released within the crack plane by capillarity. Polymerization was triggered by contact with a transition metal catalyst incorporated in the matrix [11].

Remineralizing composites- Calcium orthophosphate (CaP) particles have been studied since long as ion-releasing fillers in resin-based composites. Calcium and phosphate ions released from the composite would make the surrounding medium supersaturated, favouring their deposition on the enamel hydroxyapatite (HAP) crystals. Composites containing CaP particles are considered "smart materials" because ion release increases in more acidic conditions due to an increase in particle erosion [9,12].

Antibacterial composites- While adhesive systems containing antibacterial agents have been on the market for several years, restorative composites with antibacterial activity are still under development. Ideally, antibacterial composites must meet a critical set of requirements, including:

a. Non-toxic,
b. Antibacterial action for a broad spectrum of microorganisms and
c. Maintain a long duration effect. Also, it is very important that incorporation of antibacterial agents does not compromise the mechanical and optical properties of the restorative material [13,14].

Recent advances

1. Silver diamine fluoride-SDF is a silver-based fluoride liquid used to arrest carious lesions by denaturing and breaking down bacteria in the infected lesion. SDF is an adjunct to restorative care because of its ability to penetrate dentinal tubules and prevent sensitivity in deep lesions when used in indirect pulp therapy. SDF, if alone, has the ability to arrest incipient lesions. Arresting these lesions has the potential to eliminate the need for treatment under general anesthesia or restorative care in young children who are not able to cooperative in a normal dental setting [15,16].
2. Active Bioactive Restorative-Bioactive materials that behave favourably in the moist oral environment, neutralize conditions that cause dental caries, provide prevention benefits, and maximize the potential for remineralization. ACTIVA Bio ACTIVE products are the first dental resins with a bioactive ionic resin matrix, shock-absorbing rubberized resin component, and reactive ionomer glass fillers that mimic the physical and chemical properties of natural teeth. These bioactive materials actively participate in the cycles of ionic exchange that regulate the natural chemistry of our teeth and saliva and contribute to the maintenance of tooth structure and oral health [17].
3. Biodentine-Biodentine is a calcium-silicate based material that has drawn attention in recent years and has been advocated to be used in various clinical applications, such as root perforations, apexification, resorptions, retrograde fillings, pulp capping procedures, and dentine replacement [18,19].

Conclusion

Many new developments have occurred in restorative dentistry for children in recent years. One should actually develop a clear-cut understanding of the unique features, strengths, weaknesses, and requirements of each material available to be able to apply the right material in the right situation. Further development of the already existing materials will make them more user-friendly and can have improved properties. Development in new areas will likely add materials to the selection portfolio in the near future.

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Volume 2 Issue 11 November 2018