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Paediatric dentistry: Glass ionomer or giomer?

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Abstract

Introduction: Giomers are composed of PRG fillers which in turn contain some ions, in addition to fluoride, which are beneficial to enamel so, it could be used for remineralization. Glass ionomer also contains fluoride and has been a commonly used material for many years.

Objective: to analyze information about its chemical composition, physical properties, chemical properties and application of S-PRG technology in comparison with glass ionomer.

Methodology: articles were searched in PubMed, Science Direct, Springer and EBSCO. Terms such as S-PRG OR GIOMER, S-PRG AND prevention, glass ionomer AND pediatric dentistry were used.

Results: S-PRG has a pre-reactive glass ionomer layer containing reactive ions that acts in contact with water and saliva, thus releasing ions that promote remineralization, bacterial control, etc. It has lower setting shrinkage compared to some ionomers and allows remineralization around the restoration and can be used as a restorative material for primary and permanent teeth. Glass ionomer has an acid-base reaction. By bonding glass ionomer filler to resins, it improves their properties, is successful in the presence of secondary caries and is well accepted as a restorative material after selective removal of carious tissue.

Conclusion: Both materials have fluoride releasing and recharging capabilities as well as restorative properties. However, giomer has better esthetic advantages. Further studies are required because giomers are relatively new.

Keywords: giomer, glass ionomer, pediatric dentistry, S-PRG filling

1. Introduction

There are materials that prevent demineralization and also have continuous fluoride release, among other properties that benefit enamel [1,2].

Caries is one of the most prevalent oral diseases [3].

Mineral depletion in the enamel causes hypomineralization, which increases susceptibility to caries [4].

The prevalence of early childhood caries (ECC) is between 23% to 90% in several countries [5]. It has been observed that ECC is often not treated in time and therefore continues to have a high prevalence [6]. An association of molar incisor hypomineralization (MIH) with cavitated carious lesions was found [7].

A toothpaste filled with surface pre-reacted glass ionomer (S-PRG) is more effective in demineralization than sodium fluoride at 1100 ppm [8]. *In vitro* studies have found glass ionomer (GI) materials to inhibit caries [9].

There is no adequate review of giomers in comparison with glass ionomer, therefore, the aim of this study is to analyze the information about their chemical composition, physical properties, chemical properties and application of giomer in comparison with glass ionomer.

2. Methodology

Information from articles published in PubMed, Science Direct, Springer and EBSCO was analyzed with emphasis on the last 5 years. The quality of the articles was analyzed based on the PRISMA guidelines, i.e., identification, review, choice, and inclusion.

The quality of the review was assessed using the measurement instrument for evaluating systemic reviews (AMSTAR-2)^[10].

Keywords used were: S-PRG OR giomer, S-PRG AND prevention, S-PRG AND primary teeth, surface pre-reacted glass-ionomer, composites AND color change, glass ionomer AND pediatric dentistry, giomer, (glass ionomer) AND (biomaterial).

3. Results

3.1 Chemical Composition

3.1.1 Giomer

Materials containing pre-reactive glass ionomer filler (PRG) belong to the family of gomers, this term is a combination of glass ionomer plus polymer^[11] which, unlike compomers, use pre-activated silanized and dehydrated reactive fillers. These materials do not incorporate dehydrated acidic groups or non-functional acidic groups and therefore require the use of an adhesive prior to placement^[12]. The formation of PRG is carried out by the acid-base reaction between fluoroaluminosilicate glass (FASG) and polyalkenoic acid in the presence of water, and results in a siliceous hydrogel^[13]. There are 2 types of filler with PRG technology: full glass ionomer filler (F-PRG) and surface glass ionomer filler (S-PRG)^[14]. The S-PRG filler is composed of 3 layers which in turn are composed as follows: the inner part of the filler containing the multifunctional fluorine-boron-aluminum-silicate glass, a middle layer of pre-reactive glass ionomer and a reinforced outermost layer^[1, 13, 14]. The glass ionomer layer is composed of fluoride, aluminum, silicate, among others, which provide benefits to the dental organ according to their chemical properties^[12]. In addition, it has a resin matrix which influences the biocompatibility and physicochemical properties of these materials^[15]. It has an acid-base reaction when combining FASG glass powder and polyacrylic acid, which allows the glass ionomer phase to be stable^[13].

3.2 Glass Ionomer

The conventional glass ionomer presentation consists of an aqueous solution of polymeric acid and a glass powder. This material is prepared by making a homogeneous viscous mixture for subsequent application^[16]. Those used for restorations generally consist of a mixture of polyacrylic acid (PAA) and tartaric acid that reacts with fluoroaluminosilicate glass in such a way that metal ions are released, which allows for bonding between the polyalkanoate chains^[17]. In a recent study it was found that mixtures of linear and branched PAAs are suitable for improving the mechanical properties of new GIs^[18]. The powder used for conventional ionomer usually contains aluminum oxide, silica and calcium fluoride^[19]. These are materials that do not require phosphoric acid for adhesion to the tooth, since it's done by chemical bonding. Resin-modified glass ionomer (RMGIC), in addition, have resin free radical polymerization^[17].

Ionomers and gomers are distinct materials that are similar in composition. What stands out most about these two materials is their fluoride compound, since it's an extremely important ion for restorative treatments in pediatric dentistry.

3.3 Physical Properties

3.3.1 Giomer

The water absorption mechanism that gomers have, is greater than that of some resin materials, this property is what allows the release of fluoride and other compounds from the S-PRG filler but large amount of water, has a negative result. In

addition, it has been found to have greater discoloration compared to other resins^[20]. On the other hand, another study showed that gomers have less color change and the most significant color change was obtained at 4 weeks caused by cola^[21], there is no significant color change when using mouthwash^[22], as a restorative material, compared to a resin, they react similarly to coffee pigmentation and both have acceptable color change, but when bleaching is performed it affects the translucency of both materials^[23] and compared to glass ionomer it has a better finish and less color change^[24]. Prolonged use of multivitamin syrups and effervescent tablets negatively affects hardness and roughness in both giomer and glass ionomer^[25]. The intensity of the lamp influences the dimensional changes that the giomer undergoes; greater dimensional changes have been reported if the high mode (0.23%) is used when light curing compared to the low mode (0.17%). The shrinkage of the giomer (Beautiful II) was lower than Fuji II LC when using low mode^[26]. It is important to avoid disinfecting the cavity with chlorhexidine before applying the material^[27] or contact with aluminum chloride (in class V cavities) because it increases the space between the material and the tooth^[28]. Nevertheless, it has high quality mechanical and optical properties^[29].

3.3.2 Glass Ionomer

Glass ionomer, when combined with conditioner, is most successful when used in atraumatic restorative treatment (ART)^[30]. Bonding 10% glass ionomer filler to resin-based composites increases physical properties such as hardness, flexural strength and compressive strength^[31]. The shrinkage effect of Ketac Molar Aplicap and Ketac Molar Quick Aplicap glass ionomers is less than that of polymerized RMGIC when the material is light cured^[26]. However, the latter has higher flexural strength, although lower compressive strength than conventional^[19] and, compared to a resin, has higher occlusal wear^[32]. In terms of marginal adaptation, RMGICs are better than gomers^[33]. In the absence of saliva contamination, less microleakage is present in hybrid glass ionomers and RMGIC compared to high viscosity GI^[34]. Compared to giomer and other materials, it has greater color change when using mouth rinses^[23]. It has a lower survival rate compared to resins; however, it prevents further tissue disintegration in teeth with MIH and contributes to improved patient cooperation^[35].

The giomer has a greater esthetic advantage than glass ionomer as less color change has been reported, in addition, it has less shrinkage. These qualities may be favorable for its greater longevity. On the other hand, GI proves to be very useful especially in the treatment of MIH.

3.4 Chemical Properties

3.4.1 Giomer

Fluoride, strontium and silicate ions provide remineralization of dentin^[36]. The varnish containing this filler, in its calcium type (PRG-Ca), prevents demineralization around materials containing this compound^[37]. As a varnish, it induces the release of fluoride and, in addition, has the capacity to recharge when in contact with fluoride pastes, varnishes or mouthwashes^[38]. As a sealant, it has a higher fluoride recharging property compared to sealants containing GI^[39]. According to a comparison of four different sealers, the sealer containing S-PRG was found to be the best because of the type and amount of ions it releases^[5], these ions inhibit enamel demineralization^[40]. In addition, it has been reported that adhesives with this filler show good adhesion^[13].

Another advantage is that it has antimicrobial activity which inhibits biofilm and bacterial growth [41,42].

3.4.2 Glass Ionomer

In a recent investigation, it was found that glass ionomer as a pulp capping does not cause postoperative pulp sensitivity, even in very deep cavities, indicating that it is biocompatible [43]. As a sealer, it has been shown to have greater fluoride release compared to sealers containing S-PRG [39]. They are highly cariostatic, in addition, fluoride inhibits bacterial growth and triclosan adhesion provides positive results [19]. The addition of antimicrobial compounds provides clinical benefits, however, this may decrease the mechanical properties of the GI and even decrease the release of fluoride, which has an effect against bacteria [44].

The ability of both materials to release fluoride represents a favorable property for the treatment of carious lesions and even MIH. Another advantage of both materials is the ability to recharge fluoride ions, which represents a possibility to better control caries susceptibility.

3.5 Applications

3.5.1 Giomer

S-PRG-filled materials have been shown to be effective in the remineralization of enamel in primary teeth and can therefore be considered as a material for caries prevention treatment [45,38]. Some studies have found that it has less long-term success compared to resins, however, it can be used for cervical and occlusal restorations and even in primary teeth [12], clinical and radiographic success has been reported both at 6 and 12 months in class II cavities in primary molars [46] and even maintain acceptable qualities after 13 years of follow-up [47]. Likewise, the restorative system proved to be effective in class I and II cavities in permanent molars which were followed up for 18 months [14]. On the other hand, it does not appear to be a good alternative as a sealant in erupting teeth [48]. Positive results have also been reported for 7 months when used as a restoration in teeth with MIH including the elimination of sensitivity [49]. S-PRG cements used as pulp capping induce tertiary dentin [50].

3.5.2 Glass Ionomer

Glass ionomers used for the restoration of class II cavities in primary molars have been shown to have a good response to the presence of secondary caries [51]. High viscosity glass ionomers are also used as a restoration after selective carious tissue removal in patients with MIH and have been found to be effective in maintaining the structural integrity of the crown for 2 years [52]. In addition, they are well accepted for application in (ART) [44] even in patients with ECC with follow-up for 4 years [53]. However, it has better outcome when using high viscosity GI30. RMGIC is successful when used as a base for proximal restorations in primary teeth [54].

Both giomer and glass ionomer can be used for restorations in primary and permanent teeth. However, there are currently more publications reporting success using glass ionomer because giomer is a relatively new material on the market.

4. Conclusions

Both giomer and glass ionomer are fluoride releasing materials and have the ability to be refilled with pastes, varnishes, etc. The PRG filler of giomer, creating a stable glass ionomer phase, when used as a restorative material has a greater esthetic advantage than glass ionomer. Glass ionomer has a wider variety of applications as a restorative material,

cement, pulp capping and pit and fissure sealant.

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