Comparative Evaluation of a Glassionomer Cement and a Resin Composite Used as Dental Sealants

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The aim of the present study was to compare the retention rate and caries-preventive efficiency of two types of sealing materials : a glass ionomer cement (Ionofil plus) and a nano-hybrid resin sealant (Grandio Seal) over a 2-year period. 84.78% with resin composite sealings and 7.39% of the glassionomer sealings were fully retained. New caries lesions were found in 7.82% of the glass ionomer sealed surfaces and 5.65% of the resin sealed surfaces. It can be concluded that Ionofil plus and Grandio Seal exhibit similar caries preventive effects.

Keywords: dental sealing; Ionofil plus; Grandio Seal; retention rate; caries outcome

Dental caries (tooth decay) remains the most common chronic disease of children aged 6 to 11 years (25%), and adolescents aged 12 to 19 years (59%) even it is largely preventable.[1] The caries preventive strategies currently adopted, defined as primary prevention, are focused on children by interventions provided to avoid the onset of tooth decay. Those approaches include local and general fluoridation, diet control regarding the hydrocarbonates ingestion, mechanical and chemical plaque control and dental surface sealing. [2] Oral health education plays a very important role in the prevention of oral diseases by implementing activities that have a major impact on health behaviour.

Dental sealing prevents the tooth decay by providing a physical barrier that arrests food particles from collecting and stops the growth of bacteria that produce tooth decay in the retentive zones of the teeth [3,4]. The materials used for dental sealing include glass ionomer cements, composite resins and hybrid restorative materials (Resin-modified glass ionomers (RMGI), Giomers and Compomers).The first material used for pit and fissure sealing was methyl cyanoacrylate created in 1966 by E.I. Cueto . Later, in 1970, Buonocore developed a visous resin (BIS-GMA) which represents the basis of numerous resin-based sealants available today. Glass ionomers (GI), introduced in 1972 by Wilson and Kent, set *through* an acid-base reaction between polymers of polyacrylic acid and fluoro-aluminosilicate bases. Those materials demonstrated significant advantages represented by fluoride release and chemical bonding to tooth structure but they have low early strength and moisture sensitivity during setting. Resin-modified glass ionomers (RMGI) containing acid-base and polymerizable components , show improved mechanical properties, a decreased setting time and attenuate moisture sensitivity. Their composition includes fluoro-aluminosilicate glasses, polyacrylic acid, water, photo-initiators and water-soluble methacrylate monomer (hydroxyethyl methacrylate (HEMA). [5] In 1990's, hybrid materials called compomers (polyacid-modified composite resins) showing superior qualities were introduced [6,7].

Glass ionomer cements are available in two forms, both of which contain fluoride: conventional (original chemically curable type) and resin-modified (light curable type). Available resin-based sealant materials can be polymerized by autopolymerization, photopolymerization using visible light or a combination of the two processes [3].

The effectiveness of sealants for caries prevention depends on long-term retention which can be evaluated through visual and tactile examinations. [6] In situations in which a sealant has been lost or partially retained, the sealant should be reapplied to ensure effectiveness.

The aim of the present study was to compare the retention rate and the effectiveness in tooth decay prevention of a glass ionomer cement and a resin fissure sealant during a period of 2 years after their application. The study was developed between March 2013 and March 2015.

Experimental part

Study population

It was initiated a study including total of 120 school children aged 7-8 years old , attending 18 primary schools in various districts of Iasi town, Romania. 480 teeth (240 pairs) comprising permanent first molars (4 first molars / 2 pairs per child) were selected and than sealed using a glass ionomere and a resin sealing material. Of the study group 65 children (54.2%) were boys and 55 (45.8%) of them were girls. The selection of the patients who will benefit from the sealant application was based on the indications of this procedure as a caries primary prevention method:

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patients with high caries risk, occlusal pits and fissures of permanent molars, cooperative patients with good oral hygiene. Exclusion criteria included teeth with proximal caries, patients with poor oral hygiene, uncooperative patients.

Written parental consent for children participation in the study was obtained. Children themselves also had the opportunity to accept or refuse their participation in the study. It was ensured the confidentiality of the obtained data.

Clinical examinations took place in the school dental offices, in conditions of a strict compliance to infection control protocols. Sealant applications were performed by 4 calibrated dentists, resulting in a Kappa index with values ranging between 0.73 and 0.84. The teeth to be sealed were examined using a flat mirror and a WHO probe and the light of the dental unit.

Sealant

The materials used in the study were Ionofil plus, a glass ionomer sealant material (VOCO GmbH, Germany) containing fluorosilicate glass and polyacrylic acid, and Grandio Seal, a light-curing, fluoride-containing nano-hybrid composite sealant (VOCO GmbH, Germany) containing 70% w/w inorganic fillers in a methacrylate matrix (Bis-GMA, TEGDMA). A split mouth design was used in this study. The sealants were randomly applied on contralateral teeth , each tooth in the pair receiving a glass ionomer or a resin , respectively.

The sealant application protocol followed the recommendations for effective placement and long-term retention and included bacterial plaque and salivary pellicle removing by professional brushing using a fluoride-free abrasive prophylaxis paste, rinsing and air-drying of dental surfaces, acid etching of the dental surfaces and maintaining a dry field uncontaminated by saliva until the sealant is placed and cured. Where necessary, a standard fissurotomy bur was used to widen the occlusal pits and fissures of the permanent first molars.

For the teeth sealed with the glass ionomer cement, the material was prepared according to manufacturer's instructions, by mixing the powder into the liquid (30-40 seconds). After the material insertion in the pits and fissures, a protective varnish was applied (Easy Glaze, VOCO, Germany), in order to protect it from humidity and drying out. 5-6 min after application, excess material was removed with sharp instruments, then the protective varnish was reapplied.

The occlusal surfaces sealed with Grandio Seal were etched with 37% ortho-phosphoric acid gel for 30 s, then rinsed with air/water spray for 20 s and dried with air spray (free from water or grease), until a uniform whitened surface with a chalk-like appearance was obtained. For the resin sealant is was necessary to use a light-curing bonding agent. The Grandio Seal was applied from the margin into the fissure and allowed to penetrate for 15-20 seconds, removing any air bubbles with the fine cannula. The sealant was polymerised for 20 seconds with halogen polymerisation devices with the light output of at least 500 mW/cm^2. Excess material was removed with finishing diamond burs.

Clinical evaluation

The children were re-examined at 6, 12, 18 and 24 month after the sealant application. Visual inspection and the tip of a blind probe were used to check the retention and condition of the sealants at evaluation. The retention rate was assessed as follows: full retention (FR), partial retention (PR) and complete loss (CL). No resealing was performed after the follow-up examinations. The diagnostic criteria for caries were consistent with those of the World Health Organization Oral Health Survey [9]. Visual examination and tactile inspection were used to assess the presence (P) or absence (A) of new dental caries.

Statistical analysis

Data were statistically analyzed using the SPSS (Statistical Pakage for Social Sciences) 17.0. Because of the split mouth study design use, either one or two tooth pairs were observed per mouth, which required the use of the modified McNemar's test (dependent pairs) [10]. Each mouth was considered as a cluster and the observation treated as a matched pair (glass ionomer cement / resin sealant). The percentage of presence or absence of new dental caries was also statistically analyzed. The cut-off point of statistical significance was set at 0.01.

Results and discussions

At the beginning of the study, sealants were applied to 120 children, which were also available (100%) for the first re-examination 6 months after the application . The number of the examinated children after 12 months was 118 (98.33%), 117 (97.50%) after 18 months and 115 (95.83%) for the 2 year follow-up examination.

The retention rates of the glass ionomer cement sealings were 73.74% after the first 6 months and 21.74% at the 2 year examination, including both full retention and partial retention (fig. 1). For the resin sealings, the retention rates were 100% after the first 6 months and 91.31% at the 2 year examination (full retention and partial retention) (fig. 2).

At the final examination, 7.39% of the glassionomer sealings and 84.78% of the resin sealings were fully

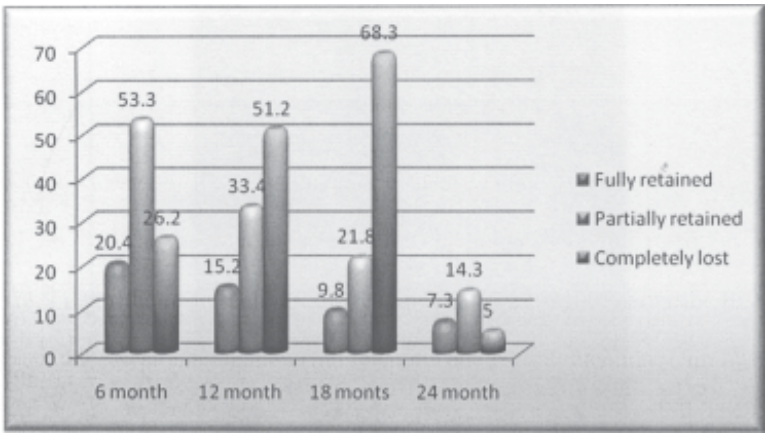

Fig. 1. Retention rates of the glass ionomer cement sealant

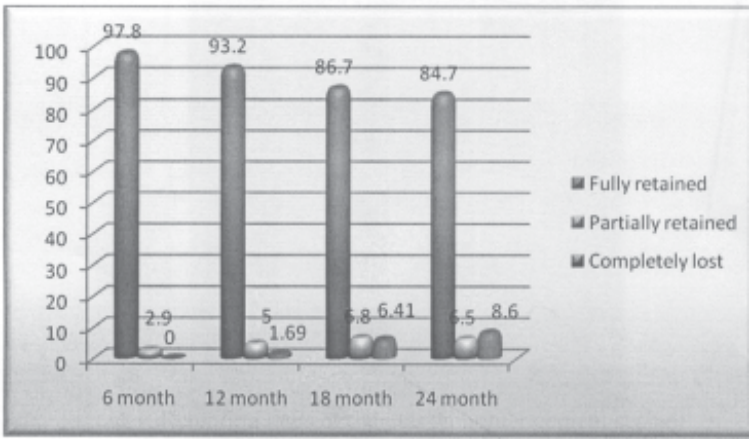

Fig. 2. Retention rates of light-cured resin sealant

Caries	6 months	12 months	18 months	24 months
Present	0	0	11 (4.70%)	18 (7.82%)
Absent	240 (100%)	236 (100%)	223 (95.30%)	212 (92.18%)
Total	240 (100%)	236 (98.33%)	234 (97.50%)	230 (95.83%)

Table 1
CARIES OUTCOME FOR THE GLASS IONOMER CEMENT SEALANT

Caries	6 months	12 months	18 months	24 months
Present	0	0	8 (3.41%)	13 (5.65%)
Absent	240 (100%)	236 (100%)	226 (96.59%)	217 (94.35%)
Total	240 (100%)	236 (98.33%)	234 (97.50%)	230 (95.83%)

Table 2
CARIES OUTCOME FOR THE LIGHT-CURING RESIN SEALANT

retained, 14.35% of the glassionomer sealings and 6.53% of the resin sealings were partially retained and 78.26% of the glass ionomer sealings and 8.69% of the resin sealings were completely lost.

The differences between the two materials concerning the retention rate were found to be statistically significant ($p < 0.01$) for all of the re-examinations.

Caries outcome evaluation showed that all of the sealed teeth remained caries-free for the first 12 months of the study. At the re-examination performed 24 months after the sealants application, 7.82% of the occlusal surfaces sealed with glass ionomer cement (table 1) and 5.65% of the surfaces where the resin sealant was applied showed new caries lesions. These differences were not found to be statistically significant. (table 2).

The results of the present study showed that the investigated light-curing resin sealant proved a good performance in sealing the occlusal pits and fissures of the first permanent molars: 84.78% of the sealings were fully retained 2 years after their application. These results are consistent to the findings of other similar studies which demonstrated the qualities of this type of material as sealing agent (Baseggio et al, 2010; Kervanto-Seppälä et al, 2008; Subramaniam et al, 2008) [11-13]. However, when recently erupted teeth need to be sealed, resin-based sealants have a considerably lower retention rate because of the difficult tooth isolation and, consequently, saliva contamination [14]. In these conditions, the use of a glass ionomer cement sealant seems to be a good alternative, not only because of the simple technique without intermediate steps such as acid etch, primer and bonding agent applications, but also because of its biocompatibility and, above all, capacity of fluoride release . Many authors demonstrated a caries preventive effect of glass ionomer sealants even after sealant clinical loss, because in the deeper part of the fissures there is still enough material to prevent caries [15, 16].

Effectiveness of a sealant as a caries preventive agent depends on its full retention. The high retention rate reported in this study for resin sealant may be due to the fact that it is easy to apply, has a good flow, an unlimited working time , a less chance of air bubble incorporation and no mixing is required. [17]. The glass ionomer sealant exhibits low technique sensitivity, good adherence and fluoride releasing property. It acts as a reservoir from which the added fluoride is gradually released into the oral cavity to inhibit enamel demineralization and enhance remineralization. Similar results were reported by Ninawe et al when comparing Helioseal-F sealant and Fuji VII glass ionomer sealant [18], and by Chen et al when comparing Concise and Fuji VII [19, 20].

In the present study, only 8.69% of the resin sealings were completely lost at the 2 year examination, compared to 78.26% of the glass ionomer sealings. However, when comparing the two types of dental sealants regarding to the presence of new caries lesions after 2 years, it can be assumed that the preventive effect of the remaining glass ionomer particles in the bottom of the fissures is comparable to the caries-preventive effect of the resin sealant [21,22].

Conclusions

It can be concluded that Ionofil plus (glass ionomer cement sealant) and Grandio Seal (nano-hybrid resin sealant) exhibited similar caries preventive effects, although the retention of the glass ionomer sealant was poorer than that of the resin sealant within the two years of the study.

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