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Do light cured ART conventional high-viscosity glass-ionomer sealants perform better than resin-composite sealants: A 4-year randomized clinical trial

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ABSTRACT

Objective. The hypotheses tested were: the cumulative survival rates of dentin caries lesion-free pits and fissures of ART conventional high-viscosity glass-ionomer sealants with light-curing (high-intensity LED) and glass-carbomer sealants are higher than those of conventional ART sealants and resin-composite sealants after 4 years.

Methods. The randomized controlled clinical trial covered 405 children (mean age 8-years). Three dentists placed sealants in pits and fissures of high caries-risk children. Evaluation by two independent evaluators was conducted after 0.5, 1, 2, 3 and 4 years. The Kaplan–Meier survival method, ANOVA and *t*-test were used in data analyses.

Results. 1304 first permanent molars were sealed. 12.3% of children and 15.4% of sealants dropped out. 46 re-exposed pits and fissures, 39 (occlusal) 7 (free smooth surfaces), in 42 children developed a dentin carious lesion. The cumulative survival of dentin caries lesion-free occlusal pits and fissures in ART plus LED group (98%) was statistically significantly higher than in the resin-composite group (96.4%) and in the glass-carbomer group (94.5%). The cumulative survival of dentin caries lesion-free occlusal pits and fissures in the glass-carbomer group was statistically significantly lower than that in the conventional ART group (97.3%). For the free smooth surfaces, there was no statistically significantly difference among the four sealant groups.

Significance. Light-cured ART conventional high-viscosity glass-ionomer sealants prevented the occurrence of dentin cavities best.

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1. Introduction

Dental caries is very prevalent in most world communities [1]. In connection to the Minamata Convention on Mercury, that was officially adopted in October 2013, the World Dental Association (FDI) and the World Health Organization (WHO) advocated a reduction in restorations through emphasizing the importance of preventing dental caries [2,3]. In addition to plaque and diet control, preventive measures like the use of various modes of fluorides and that of fissure sealants have shown to be effective in reducing dental caries lesion development [4].

Resin- and glass-ionomer-based materials are used for sealing pits and fissures. The former showed higher retention rates than the latter [5] but there was no evidence of a difference in the caries-preventive effect between these two types of materials [6–8].

In communities that have organized oral care, the quality of fissure sealants can be controlled regularly but such a care system is not available in most world communities. If such communities stand to benefit from fissure sealants, a sealant material/procedure that is most effective and affordable is required. High-viscosity glass-ionomer sealants, placed according to the Atraumatic Restorative Treatment (ART) technique, do not need electricity and running water. Its use could reduce the cost of sealant application and subsequently, increase the coverage of sealant care. The bond strength of conventional ART sealant and subsequently its retention, might be increased through light-curing during the setting phase [9,10]. A high-intensity curing lamp emits heat, which accelerates the setting process of glass-ionomers [10]. Heat application increased compressive strength [11,12] and decreased microleakage [9].

Investigating the cost-effectiveness of a one-time application of four sealant procedures, including a new material (glass-carbomer) and a change in the ART procedure (light-curing conventional high-viscosity glass-ionomer during setting), started in China in 2008.

The present paper reports about the caries (dentin caries lesion-free) preventive effect of four sealants. The hypotheses tested were: the cumulative survival rates of dentin caries lesion-free pits and fissures in occlusal and free smooth surfaces of (1) conventional ART sealants with light-curing and (2) glass-carbomer sealants, are higher than those of conventional ART sealants and resin-composite sealants, after 4 years.

2. Materials and methods

The study was approved by the Research Ethics Committee of Wuhan University (No. 200704), and was registered at the Dutch Trial Registration Centre (No. 1441). Children's parents or guardians received and signed informed consent forms containing information about the aim of the study and the treatment procedures. Children whose parents declined to sign the consent form were excluded from the study.

The methodology of the study has been published previously [13]. A summary is presented below.

2.1. Study population and treatment allocation

The study was conducted in Wuhan City. An oral health epidemiological survey of grade 2 children attending five primary schools preceded it. The inclusion criteria for the study enrolment were: a fully erupted first permanent molar with no dentin caries lesion in pits and fissures, having deep and/or intermediate pits or fissures, and a mean dmfs ≥ 2.

The study was a randomized controlled trial with sealants clustered in each child. Per school, the principal investigator randomly allocated each child to one of the 4 sealant groups, using a list obtained after block randomization (12 children per block for 3 operators) that was prepared by a statistician who did not do the analyses.

As the sealant procedures were new to the three operating dentists and the two dental ancillaries, a four-week laboratory, and field-training program in a primary school was carried out before the trial began.

On the school premises portable equipment was used for placing the sealants in 1st permanent molars over a period of 2 months. Children received instructions about good oral health behavior and how to clean their teeth. The operators provided emergency treatment at baseline, and teeth with failed sealants (dentin caries lesion in re-exposed pits and fissures) were restored. Lost sealant material was not replaced.

2.2. Sealant procedures

Group 1-glass-ionomer: Ketac Molar Easymix® (3MESPE, Seefeld, Germany): positive control. Sealant application followed the ART sealant procedure [14].

Group 2-glass-ionomer light-cured: Ketac Molar Easymix® plus LED high-intensity curing-light, Elipar™ Freelight 2 (3MESPE, Seefeld, Germany), producing 850 mW/cm^2: test group. The sealant application described for Group 1 was followed, except that the sealant was cured for 60 s after burnishing.

Group 3-glass-carbomer: Glass Carbomer® (First Scientific Dental, Elmshorn, Germany): test group. Surface cleaning was done under cotton wool isolation as described for Group 1, followed by applying Glass Carbomer Tooth Cleaner (First Scientific Dental, Elmshorn, Germany) over the tooth surface for 20 s and washing and drying of the surface with two wet and dry cotton pellets, respectively. The glass carbomer capsule was mixed for 15 s in a Rotomix™ (3MESPE, Seefeld, Germany), extruded onto the tooth surface, spread into a thin film, covered with Glass Garbomer Surface Gloss (First Scientific Dental, Elmshorn, Germany) and held under finger pressure for 5–10 s. After bite adjustment, the material was light-cured for 75 s with the same LED lamp as used in Group 2.

Group 4-composite resin: Clinpro® (3MESPE, Miniapolis, USA): negative control. The pits and fissures were cleaned with a rotating brush: Prophy Angle (3MESPE, Wuhan, China), and a No. 6 explorer, acid etched with Scotchbond™ etchant (3MESPE, St. Paul, Minneapolis, USA) for 20 s, rinsed and dried using a 3-way syringe, and isolated using a portable suction machine. The sealant material was placed in the pits and fissures, manipulated with an explorer to free potential air-bubbles and cured for 20 s with the LED curing light 1 mm