# **Resin Composite Sealant with bis-GMA**

## In vitro and in vivo Study

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Selection of sealing material is a problem in terms of long-term durability. In this regard, we have been investigating the in vitro structure and in vivo retention of composite resin sealant with BIS-GMA. Bi-dimensional and three-dimensional analysis by AFM highlights a homogeneous structure with no structural retaining areas of the material. Comparative in vivo and vitro evaluation of sealing resin revealed a correlation of the analyzed aspects in terms of the retention of the material used.

Keywords: caries prevention; pit and fissure sealants; resin-based sealants, Bis-GMA

Dental caries prevention is a desideratum that belongs to both dentists and patients and is represented by a complex of methods including, in addition to general or local fluoridation, buccal dental hygiene and diete hygiene, dental sealing. Sealing is a method of immunising dental hard surfaces with increased reliefs in patients with high carious risk. The primary objective of the seal is to close the coronary retention shields to newly erupted teeth to prevent the bacterial plate stagnation areas from turning into ecological niches of caries, favoring the cleaning and self-cleaning of retaining surfaces. Selection of sealant material is dependent on the patient's age, child's behavior, and the time of teeth eruption[1]. Dental sealants reduce the incidence of caries after some studies by 76% on sound occlusal surfaces, compared to the non-use of sealants during the two to three year follow-up period [2]. As a result of these the aim of the study, we have been investigating the *in vitro* structure and *in vivo* retention of sealings made with a composite resin sealant: DEFENSE CHROMA (ANGELUS®, Brasil). The objectives of this study are assessing the degree of oro-dental hygiene by analyzing the OHI index, caries risk assessment; the need for orthodontic treatment assessment by IOTN and seal integrity assessment 6 months after application.

## **Experimental part**

Material and method

A composite resin sealing material was used in the study: DEFENSE CHROMA (ANGELUS®, Brasil). The reasons for selection of this material were based on the properties of its composition and results obtained in the in vitro prestudy, namely: the degree of surface roughness assessed by AFM analysis [3], material shade: thermochromic sealant, changing color to temperatures lower than 37 degrees C (favoring clinical evaluation of sealant presence), fluoride content, filling degree - 50%, showing wear resistance. To conduct the *in vivo* study, a number of 17 patients were selected for 80 seals and then we evaluated the retention of preventive sealing material over time, 6 months after application. The criteria for selecting the observation sheets were as follows: clinical data on odontal status - permanent molars I and II, without cavitary carious processes; patients evaluated within 6 months of

application of the sealant to the occlusal surface of the permanent receiving molars. The parameters selected from the clinical exam were as follows: the patient's caries risk; OHI index; IOTN index; absence of carious lesions at first and second permanent molars; the initial sealing requirement; the presence / absence of the sealant at the evaluation made 6 months after the maneuver. The database was made using the software SPSS 14.0. Tooth sealing was performed according to the sealing protocol indicated by the manufacturer. After sealing, the patient reassessment was done every 6 months according to the CCS-SES System (Color Coverage Caries - System Evaluation Sealants): Evaluation of the sealants, is very important in the correct identification of the sealant and the diagnosis of the caries / in the incipient carious lesions, it is recommended to use a transparent sealing material to allow for the visualization of possible changes), the area covered by the sealant (because it indicates the degree of efficiency of the sealant) of the carious lesions on the tooth surface [3].

## **Results and discussions**

Concerning the caries risk of the selected patients, the highest percentage is given by an increased caries risk of 76.47%; the same frequency of caries for the patients with small and medium risk with 11.76%. Bi-dimensional and three-dimensional analysis by AFM highlights a homogeneous structure with no structural retaining areas of the material (fig. 1,2).

OHI oral hygiene index is made up of the following percentages: 5.88% of subjects have a proper hygiene (OHI-0), 29.41% have a mean oral hygiene (OHI-1), 64.71% of subjects have improper oral hygiene (OHI-1). Although the IOTN (Index of Orthodontic Treatment Need) index may interfere with good retention of the sealing material, and sealing is contraindicated in patients with occlusive disorders present in patients with dento-maxillary abnormalities, these have been performed to minimize RC patients. The calculated percentages are as follows: 11.76% of patients show normal oclusion with IOTN=0, 23.53% of patients have minor changes in IOTN=1, for 35.29% of patients have changes in oclusion reports of up to 2 mm with IOTN=2, and 5.88% of patients show

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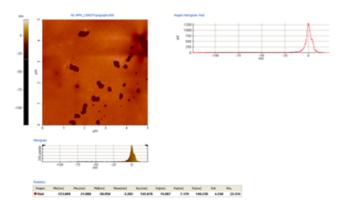


Fig. 1. Imagine 2D (XEI-Image Processing and Analysis software) AFM - 5µm analysis of a composite resin sample - DEFENSE CHROMA (ANGELUS®, Br

changes in oclusion reports up to 4 mm with IOTN=3, 23.53% of subjects have an IOTN=4 - changes in oclusion reports greater than 4 mm.

In the clinical examination of patients after 6 months of application of the sealant, sealing of the sealant in the permanent molars I was as follows: 92.65% (63) of the seals performed had a 100% sealing material retention and 7.35% (5) of the seals performed a 50% - 100%.

In the case of second permanent molars, the retention of sealing material is 100% 6 months after application. Of the total number of seals made with DEFENSE CHROMA composite resin based on the clinical examination of patients 6 months after application, the retention of sealant from permanent molars I and II was as follows; 94% (75) of the total seals performed had a 100% sealing capacity and 6% (5) of the total seals performed had a retention of sealing material between 50% and 100%. In this in vivo clinical study, sealing was performed with DEFENSE CHROMA (ANGELUS®, Brasil) composite resin sealing material on retention 6 months after application. The selection of the material was based on the sealant characteristics exhibited by the manufacturer and on the results of the in vitro in vitro study, where the characteristics of 4 composite resin based sealants used in dental practice were evaluated: Fissurit® FX (VOCO, Germany) - without filler; DEFENSE CHROMA (ANGELUS®, Brasil) - 50% filler; WAVE (SDI, Australia) - 63% nanofilles; PermaFlo ™ (Ultradent, USA) - 68% nanofiller. The analysis of the roughness of the material as well as its complication in the enamel substructure were analyzed by AFM and SEM images. According to other studies, preparation of the tooth surface is not necessary for our study by making only a seal application according to the protocol [7-9]. Although the nanotechnology in dentistry is developing very fast [15,16] the toxicity of Bis-GMA material is questionable, being studies that agree and disagree with this [10-14]. It is known that the viscosity of the composite materials is influenced by the percentage of inorganic particles contained therein. The filler particles increase the wear resistance of the material, reduce the coefficient of contraction of the socket and the linear thermal expansion and ensure the physionomic appearance. The nuances of composite resins influences polymerization but also clinical evaluation after application. A darker / opaque shade will result in a diminution of light beam penetration and cohesiveness of the material, inhibiting polymerization in deep layers, persistence of unreacted monomer, and impairment of mechanical properties [17, 18]. Also, the darker / opaque shades does not allow the surface to be evaluated under seal. Therefore, by analyzing these characteristics DEFENSE CHROMA (ANGELUS®, Brasil)

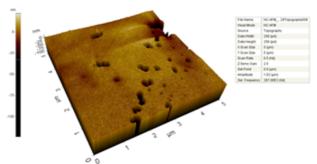


Fig. 2. Imagine 3D (XEI-Image Processing and Analysis software)

AFM - 5 μm - analysis of a composite resin

sample - DEFENSE CHROMA (ANGELUS\*, Brasil)

proved to be the best option by summing up the characteristics: satisfactory degree of roughness, low percolation degree, thermochromatic character translucent at the temperature of the oral and bluish cavities at lower temperatures, content of 50% inorganic charge and fluorine content. Seals partially present at the 6-month evaluation were recorded in the 5 patients with IOTN of 4, which could suggest an interference with sealing material adhesion. Although sealing is contraindicated in patients with occlusal disorders, in order to minimize the risk of carious lesions in these patients, which have an accentuated occlusal morphology at the permanent molars, sealing has been done, knowing that the loss of the sealant (partial or total) leaves the tooth equally susceptible to caries as if it had not been sealed [19, 20]. Simonsen R.J evaluated the retention rate according with other studies into intact sealant, partial loss, and complete loss [21], however, Mickenautsch and Yengopal do not support the use of sealant retention as a valid predictor for caries manifestation [22]. Other factors that could have contributed to the partial loss of the sealant are linked to the sealing protocol, eg salivary enamel etching, incorrect application of the material, or overfilled of premature contacts. Adequate moisture isolation is the most critical step in sealant application and the etching also [23-31]. The results of this study were optimal at the 6-month evaluation, with 94% seals being present at a rate of 100%. However, the evaluation period was only 6 months to follow up the results of the six-monthly 6-month evaluations to allow us to express our long-term efficacy. These results may be comparable to the results of other studies [32-35].

Other study which evaluated the retention of resin-based filled sealant is higher than resin-based unfilled sealant at the 12-month follow-up but the difference was not statistically significant [36].

### **Conclusions**

Within the scope of this seal evaluation study with a composite resin sealing material, 6 months after application, we can draw the following conclusions:

- Dental seals showed a 100% retention for 94% of seals proven to be effective in the primary prevention of dental caries;
- Although 50% of the inorganic particulate matter has been sealed with sealant resistance, the sealant being lost only partially between 50% -100% for 6% of the seals, increased attention should be paid to removing existing premature contacts which may interfere with retention and finally the success of seals;
- Composite resin materials differ in composition and characteristics. Assessment of their characteristics, before choosing a sealant, and careful observation of the instructions and application steps, improve the final seal

results, through effective retention, resistance to mechanical and physico-chemical stresses, inhibition of bacterial plaque adherence, along with the presence of fluoride, thus preventing the appearance of dental caries.

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