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ORIGINAL ARTICLE

Influence of dental materials used for sealing caries lesions on laser fluorescence measurements

Paula Celiberti · Thiago S. Carvalho ·
Daniela P. Raggio · Fausto M. Mendes

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Abstract The aim of this study was to determine the influence of thickness and aging on the intrinsic fluorescence of sealing materials and their ability to block fluorescence from the underlying surface as assessed using a laser fluorescence device. Cavities of 0.5 mm and 1 mm depth were drilled into acrylic boards which were placed over two surfaces with different fluorescence properties: a low-fluorescence surface, to assess the intrinsic fluorescence of the sealing materials, and a high-fluorescence surface, to assess the fluorescence-blocking ability of the sealing materials. Ten cavities of each depth were filled with different sealing materials: Adper Scotchbond Multi-Purpose, Adper Single Bond 2, FluroShield, Conseal f and UltraSeal XT Plus. Fluorescence was measured with a DIAGNOdent pen at five different time points: empty cavity, after polymerization, and 1 day, 1 week and 1 month after filling. The individual values after polymerization, as well as the area under the curve for the different periods were submitted to ANOVA and the Tukey test ($p<0.05$). At 0.5 mm, Scotchbond, FluroShield and UltraSeal showed insignificant changes in intrinsic fluorescence with aging and lower fluorescence after polymerization than Single Bond and Conseal. At 1 mm, Scotchbond and FluroShield showed the lowest intrinsic fluorescence, but only Scotchbond showed no chagnes in fluorescence with aging. At both depths, Scotchbond blocked significantly less fluorescence. All sealing materials blocked more fluorescence when applied to a depth of 1 mm. At 0.5 mm, fissure sealants blocked more fluorescence than adhesives, and did not show significant changes with aging. Scotchbond had the least affect on the fluorescence from the underlying surface and would probably have the least affect on the monitoring of sealed dental caries by laser fluorescence.

Keywords Dental adhesive · Fissure sealant · Laser fluorescence · DIAGNOdent pen · Intrinsic fluorescence

Introduction

The success of fissure sealants in preventing the development of caries lesions for up to 20 years after application, added to evidence of the arrest or diminished progression of caries lesions by sealing, has led to the introduction of noninvasive methods of caries lesion management. Initially, the sealing was restricted to white-spot lesions, and the effectiveness of this method on infiltrating the lesions and preventing further demineralization and progression has been shown in several studies [1–6].

Recently, the sealing of caries lesions that have already reached the dentine and exhibit microcavitation has been proposed. As lesion activity is directly related to biofilm activity, sealing these lesions should provide a physical barrier between microorganisms and substrate, rendering the lesion inactive. The sealing of occlusal caries lesions has been advocated and has been proved to be successful in several studies [7–10]. More recently, sealing of approximal caries lesions has shown promising results in arresting these lesions [11, 12]. However, the monitoring of caries lesions after sealing in the both

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P. Celiberti · T. S. Carvalho · D. P. Raggio · F. M. Mendes
Department of Pediatric Dentistry, School of Dentistry,
Universidade de São Paulo,
São Paulo, Brazil

P. Celiberti (✉)
Departamento de Odontopediatria, Cidade Universitária,
Av. Prof. Lineu Prestes, 2277,
São Paulo, SP 05508-000, Brazil
e-mail: paulaceliberti@hotmail.com

occlusal and approximal surfaces is an important issue to confirm the success of this procedure.

Conventional methods of caries detection, such as visual, tactile and radiographic methods, have shown poor reliability [13] and they are not quantitative, hindering the monitoring of the lesions. A further concern about radiographic methods is that variations in the incidence of X-rays on the film in relation to the vertical and horizontal angulations, and position of the film in the mouth, might interfere with the correct follow-up of the lesions.

An adjunct method, based on laser fluorescence (LF), has been developed for the detection of caries lesions. Based on the DIAGNOdent (Kavo, Biberach, Germany), which was designed to detect caries lesions on the occlusal and smooth surfaces, a new device, called DIAGNOdent pen (Kavo), was developed to assess both the occlusal and approximal surfaces. The device consists of a diode laser which emits a light at a wavelength of 655 nm that is absorbed by dental tissues and is partially re-emitted as near-infrared fluorescence. The system collects this fluorescence and provides quantitative measures on a scale from 0 to 99. The higher the number, the deeper the caries lesion [14].

As this new LF device has been shown to detect occlusal and approximal caries lesions accurately and reliably [15–18], and it uses a quantitative scale, it could also be used in the monitoring of caries progression after noninvasive treatment on these surfaces. Nevertheless, to test the device for use in the monitoring of caries lesions after sealant procedures, it is necessary to ensure that the LF readings are not influenced by the presence of sealant.

Thus, the aim of this in vitro study was to determine the influence of thickness and aging on the intrinsic fluorescence of fissure sealants and dental adhesives used for sealing caries and their ability to block the fluorescence from the underlying surface as assessed by LF measurements.

Materials and methods

Specimen preparation

Two 2-mm-thick acrylic boards were used in order to ensure a standard substrate for the analysis of the intrinsic fluorescence of the sealing materials and to facilitate handling without damage to the specimens. In order to assess the influence of the thickness of the sealing materials, 0.5-mm-deep cavities were prepared in one board 1-mm-deep cavities in the other. All cavities were 1.8 mm in diameter. On each board, 50 standardized cavities were placed with a flat-end diamond bur with a fixed stop (2294, KG Sorensen) at high speed under water cooling. As this bur exhibits an active point of 1 mm, an extra stop was used to avoid the bur penetrating more deeply and thus a depth of 0.5 mm was achieved. The cavities were drilled 1 cm apart. The cavities were numbered sequentially and groups of ten cavities were randomly allocated to five groups (Table 1). All cavities were vigorously rinsed with water/air-spray for 15 s and dried with oil- and water-free compressed air for 10 s.

Baseline LF measurements

The mode of operation of the new LF device used in this study has been described in detail previously [18, 19]. The boards were placed over two surfaces of standard fluorescence, a 4-mm milky white acrylic board, and pigmented paper. The first surface had a low fluorescence value (close to zero) allowing the measurement solely of the intrinsic fluorescence of the sealing material. The second surface had high fluorescence values of around 47.2 for a thickness of 1 mm and 14.7 for a thickness of 0.5 mm allowing the measurement of any decrease in fluorescence after the application of the sealing material, which would indicate the ability of the material to block the fluorescence of the underlying surface. In order to assess how much fluorescence was allowed to pass through the sealing material, without any effect of its own intrinsic fluorescence, the values obtained from the first surface (low fluorescence) were subtracted from the values from the second surface (high fluorescence). After calibration of the LF device against the ceramic reference, measurements were carried out with tip number 2, designed for occlusal and smooth surfaces. The tip was positioned at the center of the cavity and moved around in its vertical axis until the peak value was reached and recorded. The measurements were performed sequentially in groups of ten cavities, and then they were calibrated and repeated. Three independent measurements were carried out for each cavity, and the mean value was calculated.

Sealing the cavities

For the Scotchbond group, the primer was brushed through the whole cavity with a microbrush and gently air-dried. The cavities were then filled with the adhesive using a new microbrush. Single Bond was applied in two layers using a microbrush. Before the second layer was applied, the adhesive was gently air-dried. The amount of adhesive placed on each layer was enough to fill half of the cavity. As all three fissure sealants used are available in syringes, for the FluroShield, Conseal and UltraSeal groups, the material was placed directly into the cavities using the needle provided. Care was taken to neither under-fill nor over-fill the cavities. The sealing materials were light-cured for 20 s with a LED light curing device (Radii Plus, 1,500 mW/cm^2; SDI, Bayswater, Victoria, Australia). For the first 5 s, the device was held at a fixed distance of 2 mm from the sealing material. During the following 15 s the tip of the device was kept completely in contact with the board/sealing material surface. After polymerization, the oxygen-inhibited layer was removed using a cotton-wool ball held in tweezers. During the whole procedure, the boards were always manipulated using gloves. The boards were stored in a container, under 100% humidity, with no contact with the humidifying solution, at 37°C.

LF measurements

The LF measurements were carried out on each sample as previously described. Instead of the center of the cavity, the measurements were taken at the center of each light-cured sealing material. Measurements were performed immediately after polymerization and the specimens were stored under 100% humidity at 37°C in order to simulate intra-oral aging. Further measurements were carried out at 24 h, 1 week and 1 month after sealing. Throughout the procedure, all specimens were kept under the same storage conditions. The sealing of all cavities, as well as their LF measurements, were performed by a single operator (P.C.).

All the procedures in this experiment, from specimen preparation to the LF measurements, are illustrated in Fig. 1.

Statistical analysis

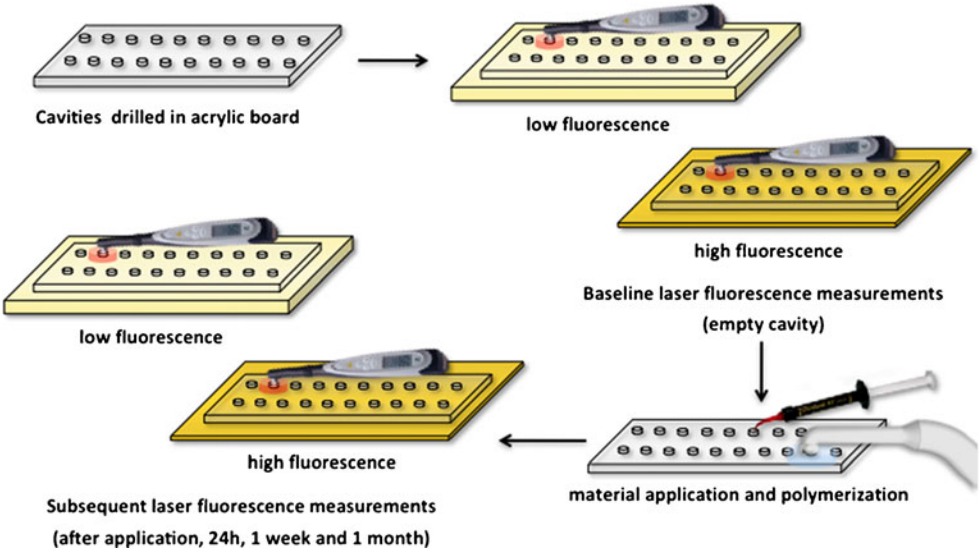
LF measurements performed on low- and high-fluorescence surfaces were analyzed separately since they were two different experiments: evaluation of the intrinsic fluorescence of the sealing materials (low-fluorescence surface) and the blocking of fluorescence (high-fluorescence surface).

Therefore, there were two independent variables for each experiment: sealing material and thickness (0.5 and 1 mm) of the material. First, the LF readings immediately after polymerization of the sealing materials on both the high- and low-fluorescence underlying surfaces were compared. Then, to investigate the influence of aging on the properties of the sealing materials, the measurements were plotted and the area under the curve (AUC) was calculated for each sample. The mean AUC value for each sealing material of different depths on the low-fluorescence surface was calculated. For the high-fluorescence surface, the values were subtracted from those obtained from the low-fluorescence surface, and the AUC was calculated. This step was carried out in order to assess the amount of fluorescence which was allowed to pass through the sealing material regardless of its own intrinsic fluorescence. Thus, four different outcomes were obtained: initial LF values (from both high- and low fluorescence surfaces), and AUC

Table 1 Materials used for filling the cavities and their respective characteristics

Group	Trade name	Manufacturer	Material	Chemical composition	Color	Filler (%)
Scotchbond	Adper Scotchbond Multi-Purpose	3 M ESPE, St Paul, MN	Two-bottle dental adhesive	Primer: hydroxyethyl methacrylate, polyalkenoic acid polymer, water. Adhesive: bis-glycidyl methacrylate, hydroxyethyl methacrylate, tertiary amines, photoinitiator	Clear	Unfilled
Single Bond	Adper Single Bond 2	3 M ESPE, St Paul, MN	One-bottle dental adhesive	Dimethacrylates, hydroxyethyl methacrylate, polyalkenoid and polyacrylic acid copolymer, 5-nm silane-treated colloidal silica, ethanol, water, photoinitiator	Clear	10
FluroShield	FluroShield	DENTSPLY Caulk, Milford, DE	Fissure sealant	Urethane-modified bis-glycidyl methacrylate dimethacrylate, barium aluminoborosilicate glass, polymerizable dimethacrylate, bis-glycidyl methacrylate, sodium fluoride, dipentaerythritol pentaacrylate phosphate, and silica amorphous, photoinitiator	Tooth-color shaded	50
Conseal	Conseal f	SDI, Bayswater, Victoria, Australia	Fissure sealant	Ester methacrylate, inorganic fillers, sodium fluoride, photoinitiator	Opaque	7
UltraSeal	UltraSeal XT Plus	Ultradent, South Jordan, UT	Fissure sealant and flowable composite	Diurethane dimethacrylate, bis-glycidyl methacrylate, photoinitiator	Clear	58

Fig. 1 Diagrammatic depiction of the procedures, from specimen preparation to LF measurements



values from the two surfaces. To compare the initial LF readings and the AUCs, two-way ANOVA and the post-hoc Tukey test were used. To compare the individual readings at each time point after the sealing procedures (24 h, 1 day and 1 week), one-way repeated measures ANOVA and the post-hoc Tukey test were used. The level of significance for all statistical analyses was chosen as $p<0.05$.

Results

The mean baseline values (empty cavities) for each group, at each depth, were not significantly different. Therefore, any differences in fluorescence from the acrylic or the underlying substrate did not influence the measurements.

Intrinsic fluorescence of the sealing materials (low-fluorescence surface)

The thickness of the sealing material was a significant factor in the intrinsic fluorescence of the sealing materials measured immediately after polymerization, and in turn influenced the LF measurements. With 0.5-mm cavities, UltraSeal and Scotchbond showed significantly higher values than the other sealing materials (Single Bond, FluroShield and Conseal; Fig. 2). With 1-mm cavities, Conseal and UltraSeal showed higher fluorescence values, indicating a greater intrinsic fluorescence at 1 mm than at 0.5 mm, while Scotchbond showed lower values, indicating a low intrinsic fluorescence (Fig. 3).

In terms of the AUC, thickness did not play a significant role in the change in intrinsic fluorescence during the experiment, except for Conseal, which showed a significant increase in fluorescence when applied in the thicker 1-mm layer, as shown in Fig. 3.

At 0.5 mm, Scotchbond and UltraSeal exhibited higher intrinsic fluorescence values after sealing and showed, along with FluroShield, the lowest AUC, and therefore showed the lowest change in intrinsic fluorescence with aging (Fig. 2). Furthermore, these sealing materials did not exhibit significant changes in their intrinsic fluorescence during the experiment. Thus, in spite of having high

Fig. 2 Intrinsic fluorescence of the sealing materials at 0.5 mm depth. The highest number on the vertical axis is the threshold for enamel caries

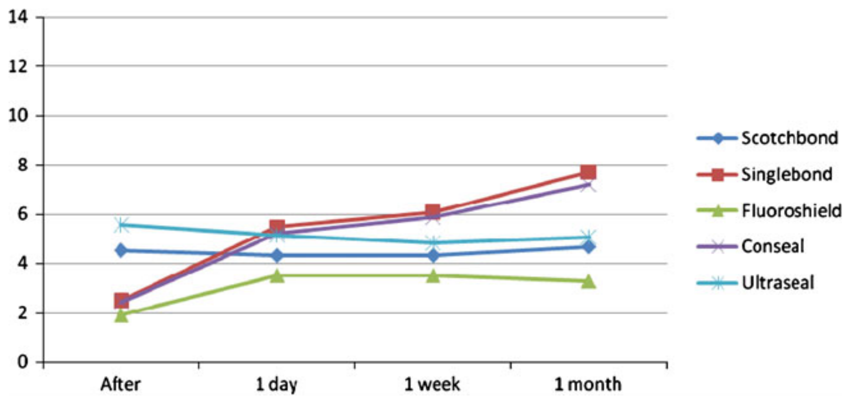
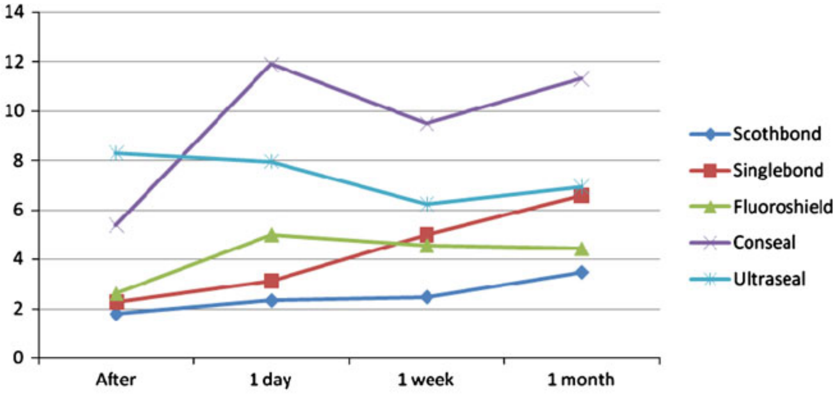


Fig. 3 Intrinsic fluorescence of the sealing materials at 1 mm depth. The highest number on the vertical axis is the threshold for enamel caries



fluorescence values immediately after sealing, Scotchbond and UltraSeal showed the lowest changes in fluorescence with aging. On the other hand, Single Bond and Conseal showed a significant increase in fluorescence from 24 h onwards which remained steady up to 1 month (Fig. 2).

At 1 mm, UltraSeal exhibited the highest intrinsic fluorescence immediately after sealing, followed by Conseal. Scotchbond, Single Bond and FluroShield which showed lower intrinsic fluorescence with no differences between them. At this depth, Scotchbond did not show a significant change in intrinsic fluorescence during the experiment (Fig. 3), and therefore showed the lowest AUC, along with FluroShield, and the lowest intrinsic fluorescence when aged. As seen in Fig. 2, Single Bond exhibited a significantly higher AUC than Scotchbond due to its gradual increase in fluorescence during the experiment. Conseal showed the highest AUC due to its high intrinsic fluorescence immediately after application and its significant increase in fluorescence from 24 h onwards.

Fluorescence blocking by the sealing materials (high-fluorescence surface)

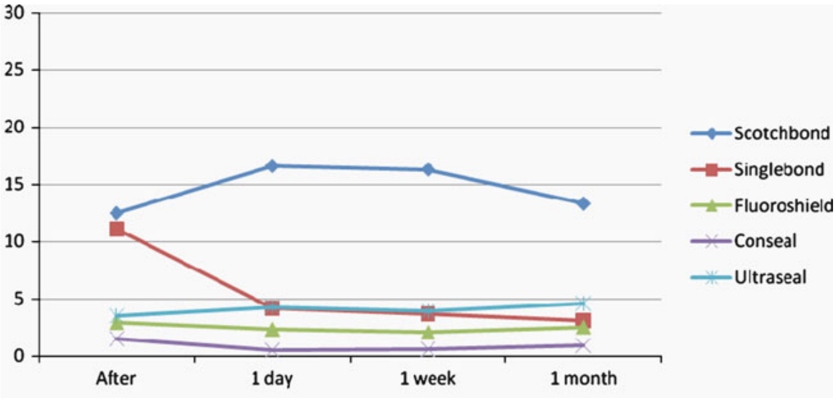
Immediately after polymerization, the thickness of the sealing materials had some influence on their ability to block fluorescence. This occurred when the sealing materials were applied in the thicker 1-mm layer (rather than in the thinner 0.5-mm layer). However, in terms of the AUC, thickness did not play a significant role in the change in LF with aging (Fig. 4).

At 0.5 mm, Scotchbond showed negative values, that is the value measured immediately after sealing was higher than at baseline. Therefore, Scotchbond blocked the lowest levels of fluorescence, but the amount of fluorescence blocked was significantly different only from the amounts blocked by FluroShield and Conseal. At 1 mm, Scotchbond and UltraSeal blocked the least amounts of fluorescence after polymerization.

In term of the AUC at both depths, Scotchbond blocked the least amount of underlying fluorescence (Figs. 4 and 5), followed by UltraSeal. At 0.5 mm, Conseal blocked a significantly greater amount of fluorescence than Scotchbond and UltraSeal (Fig. 4), while at 1 mm, FluroShield blocked a greater amount of fluorescence than Scotchbond and UltraSeal.

At 0.5 mm, throughout the the experiment, FluroShield, Conseal and UltraSeal seemed to be more stable and did not show alterations in the amounts of fluorescence blocked from the underlying surface (Fig. 4). Scotchbond and Single Bond showed an increase in fluorescence from 24 h onwards, but only Scotchbond returned to the levels immediately after application. At 1 mm, Scotchbond and FluroShield were the only materials which did not show changes in the amount of fluorescence blocked throughout the experiment. At this depth, UltraSeal showed an

Fig. 4 Fluorescence from the underlying surface passing through the sealing materials at a thickness of 0.5 mm



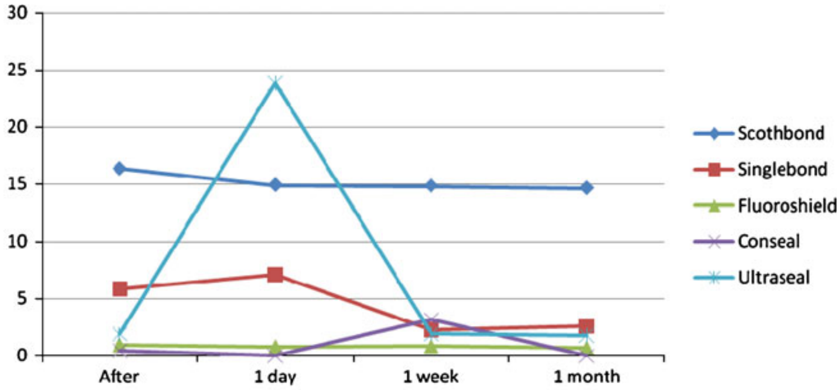


Fig. 5 Fluorescence from the underlying surface passing through the sealing materials at a thickness of 1 mm

unexpected behavior 24 h after polymerization: it allowed a significant amount of fluorescence to pass (Fig. 5). However, the value had returned to the initial level by 1 week.

Among the sealing materials, Scotchbond blocked the least amount of fluorescence from the underlying surface at both depths. Single Bond showed more rapid changes in fluorescence at 0.5 mm, blocking significantly more fluorescence at 24 h than immediately after polymerization.

Discussion

Fissure sealants were initially developed to seal sound pits and fissures, creating a mechanical barrier between the enamel and the oral environment and therefore preventing demineralization and the development of caries lesions. Fissure sealants are now increasingly being used therapeutically as well as preventively, where noncavitated and cavitated caries lesions are being sealed in order to arrest the caries process. However, an issue is still challenging for clinicians: the follow-up of these sealed occlusal and approximal lesions. For this purpose, conventional methods of caries detection are not adequate since they are nonquantitative methods. Therefore, an alternative method based on LF, which has been demonstrated to improve accuracy in caries detection [20–25], could also be used in the monitoring of sealed caries. However, the material used for sealing the lesions could influence the LF readings and thus hinder the use of this method for this purpose.

In the present study, a new LF device (the DIAGNOdent pen) was used. The measurement of fluorescence may be affected by variables related to the tooth and to the procedures carried out prior to sealing. Therefore, in this study we used acrylic boards instead of teeth in order to allow all the materials to be tested under exactly the same conditions, minimizing differences in fluorescence from the underlying surface arising from differences in, for example, tooth color and lesion depth, and in order to avoid influences on fluorescence of procedures prior to sealing when natural teeth are used, for example cleaning with polishing paste, chemical irrigation and acid etching [26, 27]. Such procedures may affect fluorescence values, influencing the LF measurements which may be confounded with the influence of the material itself. Acid etching and chemical irrigation may decrease fluorescence values, while polishing paste tends to increase LF values [26, 27].

The LF measurements performed to evaluate the intrinsic fluorescence of the sealing materials did not reach enamel caries threshold, which is around 14 [25]. Considering that no caries lesions were used in our study, these materials would not lead to false-positive readings on follow-up visits, based solely on their intrinsic fluorescence. However, when enamel caries are previously present under sealants, the application of materials which exhibit high intrinsic fluorescence could lead to false-positive readings, as the lesion fluorescence would be added to the material's fluorescence. There are other factors that should be taken into account as well as the intrinsic fluorescence of the sealing material. Opaque or filled materials may block a percentage of the fluorescence from the underlying surface, and this might lead to false-negative readings, and instability during aging may change the optical and physical properties of the material, leading to changes in LF readings. So the ideal sealing material should have low intrinsic fluorescence, should not block fluorescence from the underlying surface (or only block it to a small extent), and should be stable during aging. As adhesives have no fillers or opacifiers, it is expected that they would fulfill some of these requirements.

Adhesives have been used as sealing materials in in vitro and in vivo studies [11, 28, 29]. However, in contrast to fissure sealants, adhesive systems have hydrophilic components and, depending on their generation and components, show different levels of hydrophilicity and therefore behave differently in humid conditions [30]. The adhesives chosen for this study were a solvent-free two-bottle bonding system (Scotchbond Multi-Purpose), and a one-bottle adhesive which has water/ethanol as solvents (Single Bond). This one-bottle adhesive was preferred to formulations containing acetone due to its lower solvent loss and consequently greater chemical stability [31].

Of the materials tested in the present study, Scotchbond blocked the underlying fluorescence the least and exhibited lower intrinsic fluorescence with no significant variations during aging. The performance of Single Bond was worse than that of Scotchbond. It showed a gradual increase in intrinsic fluorescence and fluorescence blocking during the experiment. This could have been due to the fact that a difference in color and transparency was noticed only in this material. After application, Single Bond was clear, but on aging became more opaque and yellowish in color and showed random small cracks, which could be seen with the naked eye. These changes seemed to have an effect on LF measurements.

This difference in degradation between the two adhesive systems may have been a result of differences in their hydrophilicity. Single Bond is more hydrophilic than Scotchbond, showing significantly greater water sorption, solubility and water diffusion coefficients [30]. Furthermore, the use of Scotchbond (two-bottle adhesive) involves the application of only a thin layer of the hydrophilic primer and its remaining thickness comprises a hydrophobic resin-based adhesive. On the other hand, with Single Bond (one-bottle adhesive), the hydrophilic component and the solvents are present in all layers of the material. As the sealing properties of these adhesives were being tested, they were applied as a thicker layer. The increased thickness of the adhesive layer may hinder further solvent loss after air-drying [32]. The solvent which remains in the adhesive may jeopardize polymerization due to dilution of the monomers and may result in voids and in greater permeability of the adhesive layer [33–35]. A 1-mm thickness of adhesive and even sealant applied to smooth/approximal noncavitated surfaces is greater than the thickness of these materials normally applied. However, the new tendency in minimally invasive treatment is to seal microcavitated lesions. In such cases, the sum of the depth of the microcavity (enamel breakdown) and the sealant/adhesive thickness may reach the 1-mm thickness tested.

A previous study [30] has shown that Single Bond shows a significant increase in mass during the first day of storage in water and then shows a constant decrease in mass. This could be directly related to the constant increase in its intrinsic fluorescence and in its blocking ability found on the first day and after. Scotchbond also shows a great increase in mass during the first day, but contrary to Single Bond, this increase continues until equilibrium is reached on the 2nd to 3rd day and then shows a significant decrease occurs after 28 days [30]. In our study, when applied into 0.5-mm cavities, Scotchbond showed an increase in its blocking ability from the first day onwards, which returned to initial levels after 1 month. These results suggest that, when applied as a thinner layer, Scotchbond is more susceptible to changes in mass, which might be related to its ability to block fluorescence from the underlying surface. Scotchbond's intrinsic fluorescence was not altered at either depth during the whole experiment, indicating that these alterations in mass do not influence its intrinsic fluorescence.

These findings suggest that Scotchbond would be the most suitable material for use as a sealant on caries lesions allowing monitoring with the LF device. As unfilled materials, most dental adhesives would be suitable for sealing white-spot lesions, as shown in previous studies [1–3, 11]. However, for cavitated lesions, filled sealants would be more appropriate, as the addition of filler reduces the amount of matrix material which improves important physical properties by, for example, reducing polymerization shrinkage, thermal expansion/contraction and water sorption, and increasing radiopacity and diagnostic sensitivity [36]. On the other hand, due to the higher hydrophobicity of the sealants, the use of hydrophilic adhesives should be considered in those cavities that cannot be dried as well as a white-spot lesion. A cavity might remain humid due to the exposed dentin at its bottom or because of difficult access for drying. Therefore, the use of dental adhesives in cavitated caries lesions needs to be further investigated.

Among the conventional fissure sealants, UltraSeal exhibited the highest intrinsic fluorescence immediately after sealing, followed by Conseal at both depths. However, with aging the order was reversed, with Conseal showing the highest fluorescence levels which significantly increased with aging. On the other hand, UltraSeal showed only slight changes in fluorescence after 1 week, but after 1 month the fluorescence values were similar to the initial ones. This behavior may have been due to the fact that UltraSeal has a much higher percentage of filler (58%) than Conseal (7%). As UltraSeal has no opacifiers in its composition, this filler percentage might be responsible for interfering with the measurements of the underlying surface fluorescence and increasing its intrinsic fluorescence. In contrast, the filler also makes the material more stable, resulting in no or only slight changes in both parameters with aging, as shown in this study. In contrast, Conseal was more unstable and showed a significant increase in its intrinsic fluorescence from 24 h onwards. This may have been due to its low percentage of filler, which makes the material more susceptible to changes and to the presence of an opacifier, which might be a confounding factor [37]. Furthermore, the intrinsic fluorescence of Conseal was the closest to the enamel caries threshold: the value for Conseal was around 12 after 24 h and 1 month after application, when applied as a thicker layer, and the threshold value is 14.

FluroShield, which also includes filler (50%) and pigments, showed the lowest intrinsic fluorescence among the conventional fissure sealants at 0.5 mm. Its fluorescence was low immediately after sealing and showed the least change with aging. At 1.0 mm, FluroShield showed fluorescence similar to that of UltraSeal, suggesting that at this depth the opacifier has a more significant effect on intrinsic fluorescence than the filler.

When applied as a thicker layer, UltraSeal was the conventional fissure sealant that blocked the underlying fluorescence the least immediately after polymerization. At 24 h, this material allowed a significantly higher amount of fluorescence to pass through from the underlying surface, blocking less fluorescence than Scotchbond. However, its blocking ability subsequently returned to the initial levels. All samples of UltraSeal consistently showed this unexpected behavior (mean fluorescence at 1 day 23.8±2.7). We hypothesize that, as resinous materials normally take 24 h to set fully, this chemical reaction could be related to the decrease in blocking ability; this needs further study.

All conventional fissure sealants used in this study showed at least a certain degree of opacity, which was due to the presence of pigments and/or fillers. Single Bond was initially clear, but became more opaque and yellowish with aging. This material, together with the fissure sealants, blocked significantly more fluorescence from the underlying surface than Scotchbond, which remained clear throughout the experiment. This means that after placement of an opaque material, the LF readings would become significantly lower. These results are in accordance with those of previous studies [38, 39], indicating a significant decrease in LF sensitivity when an opaque material is applied. On the other hand, the placement of a clear material led to no change in LF values and consequently in its sensitivity and specificity.

Conclusion

Adper Scotchbond Multi-Purpose changed the least its fluorescence with aging and showed the least effect on the measurements of fluorescence from the underlying surface using the LF method. Therefore, it can be considered as a good material to seal noncavitated caries lesions with no significant effect on LF monitoring. However, when a filled material is required, opaque sealants should be avoided as opacity interferes with LF measurements.

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