

Twenty-four month evaluation of fissure sealants by clinical examination and quantitative light-induced fluorescence

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Summary

Objectives: The aim of this study was to evaluate the Admira Seal; a light curing Ormocer based fissure sealant, by clinical and Quantitative Light-Induced Fluorescence examinations for the loss of material, caries, plaque and marginal discoloration for twenty-four month.

Materials and Method: The examined population (32 volunteers) consisted of 149 premolars and 56 molars. Admira Seal sealant material was applied according to the manufacturers' instructions.

Results: The clinical study underlined that ormocer based fissure sealant has been found to be a successful material with low failure rate, good retention and acceptable surface texture at 24-month clinical trials under the conditions of this study. Evaluation by QLF gave more advanced results than clinical evaluation on demineralization and plaque accumulation.

Keywords: Sealant, QLF, retention, caries, plaque.

Introduction

Dental caries is a disease that has undergone dramatic changes in its prevalence; in addition it is becoming primarily a disease affecting the pits and fissures, especially in the permanent dentition [1]. The anatomy of the fissure can favor plaque stagnation and this is particularly likely during eruption of the tooth [2,3]. This happens because the tooth is below the occlusal plane and its surface tends to be missed by the toothbrush.

Although fluoride treatments are most effective in preventing smooth surface caries, they are less effective in preventing pit and fissure caries. Thus, a preventive measure for pit and fissure caries is greatly needed. Pit and fissure sealants were specifically designed for this purpose and have been demonstrated to be effective [4].

When an active enamel lesion is diagnosed in a fissure, or if a high risk is estab-

lished and fissures are sound, a fissure sealant could be indicated. An unfilled or lightly filled resin is used to penetrate the fissures and prevent plaque accumulation on the occlusal surface [5].

Fissure sealant has the advantage that the tooth does not have to be cut and no irreversible intervention is involved. Active lesions covered by the resin do not progress further and the possible development of new lesions at other sites in the fissure is prevented [6]. There is ample evidence that caries does not progress as long as the fissure remains sealed [7-9]. Even radiographically, evident caries has been shown not to progress over a 10-year period [10] provided it is sealed off from the oral environment with a composite restoration. Thus, sealing appears very effective in conserving sound tooth structure [5,11].

Early sealants were based on methylmethacrylate or cyanoacrylate cements.

Most contemporary compositions are unfilled (or only lightly filled) and based on bifunctional monomers such as those used for the matrix of composites. The principal monomer may be diluted with lower molecular weight species (e.g., triethylene glycoldimetacrylate, TEGDMA) to reduce the viscosity [1]. Ormocer based on sealant materials have been investigated. The filler material of Ormocer consists in a special glass ceramic and highly dispersed silica, incorporated into this cross-linked inorganic and organic matrix network.

QLF device is valid, sensitive, and reliable in the detection of early caries in a number of applications [12]. Since its introduction in the early '80s, the QLF technology has developed into an intra-oral technique that can be used for the detection and longitudinal monitoring of caries. This method is based on a blue light from a Xenon arc lamp with a blue filter. It has a peak intensity of $\lambda = 370$ nm with a full width half measure of 80 nm. The red and green fluorescence induced by the blue-violet light of the QLF camera can be used to monitor overall oral health. With QLF various oral health conditions can be monitored as described before: white spots, fluorosis, cheese molars, plaque/calculus/bacterially infected caries lesions. The fissures that are protected by the sealant were studied by van der Veen et al., as typical examples of QLF images [13].

One of the major problems when considering the success rates of sealant restorations is the variation in techniques and materials used. Short-term studies indicated a high degree of success for sealant restorations [14,15]. However, long-term studies appear to indicate that success is less predictable [16,17]. For direct comparison of studies with sealant restorations it is necessary to define success as 100% retention and presence of no caries on the tooth.

The **aim** of the study was to evaluate the Admira Seal; a light curing Ormocer

based fissure sealant, with clinical and QLF examinations *in vivo*.

Materials and methods

The examined population consisted of 32 (11 males, 21 females) third year volunteer dental students. The mean age of patients was 21.6 years. 149 premolars and 56 molars were sealed by the same researcher. The patients, who did not have occlusal and interproximal caries lesion, were diagnosed clinically and radiographically for the treatment. Also QLF images had been captured before the study start (*Figure 1*).

Figure 1. Evaluation by QLF of intact tooth, without marginal discoloration, plaque accumulation and caries.



Teeth were evaluated independently by two order-experienced dentists for the caries occurrence. Disagreement was resolved by consensus. Before the sealant restorations, periodontal treatment of all patients was done. Diagnoses were made on cleaned and dried teeth under illumination using visual techniques; the probe was not used in order not to destroy the lesion. Bitewing radiographs were taken for the approximal surfaces. The patients were told to brush their teeth twice a day. Polishing paste was not used, in order not to have impacted fissures. The teeth were isolated with rubber dam. For etching 37% orthophosphoric acid gel (Vococid, Voco, Cuxhaven, Germany) was applied for 60 s followed by 30 s washing

with an atomized waterspray and dried for 30 s with warm dry air. The fissures were then carefully inspected under good conditions of illumination. Admira Seal was applied according to the manufacturers' instructions using applicator tips. Following 15-20 s waiting for sufficient diffusion, fissure sealant was polymerized for 40 s by light cure (Chromalux 75, Mega-Physics Dental, Germany). Sealants were evaluated by two researchers after application and at 24-month recalls. Clinical evaluations of the sealants were made and various criteria were recorded: partial or complete loss of sealant, surface texture, marginal discoloration, plaque and caries. After 24 months, Quantitative Light Induced Fluorescence (QLF) (Inspector Research Systems, Amsterdam, The Netherlands) was used to evaluate 205 sealant restorations for those criteria: partial or complete loss of sealant, marginal discoloration, plaque retention and caries. Fluorescence loss (ΔF) of lesions was determined by QLF analyzing system.

Results

Sealant materials were evaluated by two dentists after application and at 24 months recall. After Twenty-four months with clinical observations and evaluations, it was determined that 4.8% of sealants were

partially lost (4 premolars, 6 molars), 3.9% of sealants had marginal discolorations, 3.9% of them had plaque retention and 2.4% of them were with caries. One of these caries was at the margin of the sealant material while 4 were at the place of lost sealant materials (*Table 1*).

After 24 months researchers evaluated the materials using QLF. It was found that 16.6% of sealants were partially lost (8 premolars and 26 molars), 22.4% had marginal discolorations, 52.7% plaque retention and 18.5% caries formation (*Table 1*) (*Figures 2-4*). *Figure 5a* shows a tooth with plaque accumulation and demineralization that was evaluated by QLF. *Figure 5b* shows the view of QLF's analysing program whereas *Figure 5c* shows the thresholds of ΔF . It was observed that 38 carious teeth had 66 lesion areas and 40 of them were at the margins of sealant materials while 26 were at the place of lost sealant materials. Carious surfaces showed an average ΔF of 21.9 ± 8.7 % (SD) ($n = 66$). Lesions varied from incipient ($\Delta F < 10\%$, $n = 10$) to advanced ($\Delta F > 25\%$, $n = 18$). Results indicated that QLF could be used more successfully for evaluating sealant failure and retention than clinical observations.

Table 1. Results of clinical and QLF evaluation *in vivo*

| | Clinical Examination (n=205) | QLF Examination (n=205) |
|------------------------|---|------------------------------------|
| Partially Lost | 10 4.8 % | 34 16.6 % |
| Marginal Discoloration | 8 3.9 % | 46 22.4 % |
| Plaque | 8 3.9 % | 108 52.7 % |
| Caries | 5 2.4 % | 38 18.5 % |

Figure 2. Marginal discoloration was seen by QLF at the margins of Admira Seal sealant material



Figure 3. Marginal discoloration was seen by QLF at the margins of Admira Seal sealant material

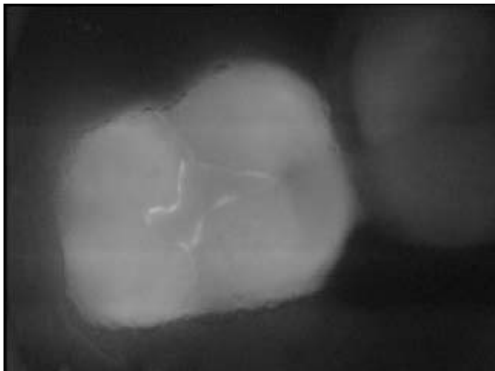


Figure 4. Plaque accumulation was seen by QLF at the margins of Admira Seal sealant material and cervical area



Discussion

Dental sealants can be retained successfully in adults. They should be considered a viable treatment alternative for adult patients who are susceptible to caries [18].

Figure 5a. Plaque accumulation and demineralization areas were seen by QLF at the margins of Admira Seal sealant material



Figure 5b. Determination by QLF of demineralization areas that were developed at the place of lost sealant materials

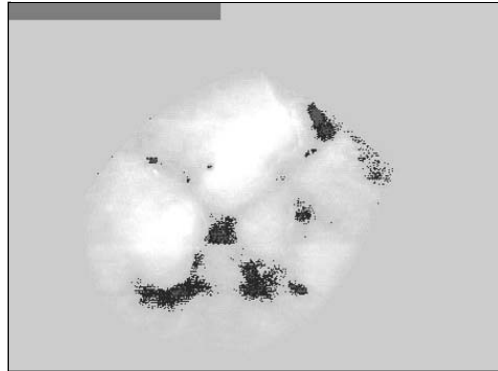


Figure 5c. Analyses results of demineralization areas of Figure 5b by Inspector Research System

| d:\qlf\sealant\umut\o38\o38001a.grp | | | |
|-------------------------------------|-------------|------------|-----------------|
| Lesion comment | | | |
| Extra zoomfactor x,y 1.00, 1.00 | | | |
| Threshold [%] | Delta F [%] | Area [mm²] | Delta Q [mm².%] |
| -5.0 | -7.4 | 4.1 | -30.6 |
| -10.0 | -12.1 | 0.7 | -7.9 |
| -15.0 | -17.8 | 0.1 | -1.9 |
| -20.0 | -21.3 | 0.0 | -0.7 |
| -25.0 | -25.0 | 0.0 | -0.0 |
| -30.0 | 0.0 | 0.0 | 0.0 |

In the present study by clinical examination 4.8% and by QLF examination 16.6% of sealant materials were partially lost. Bravo et al. [19], resulted in their study that 10.5% of Delton sealant material developed caries after 24 months while in this study 18.5%

(determined by QLF) of Admira Seal developed caries after 24 months (*Table 1*). Boksmann and Carson [20] showed in their study that the total retention rate was 96.3% for UltraSeal XT and 91.4% for FluoroShield and there were no new carious lesions over the two years. In addition of this, do Rego and de Araujo recorded no occlusal carious lesions and few total or partial losses of sealant were found after applying FluoroShield and Delton Fluor over 24 months [21]. Also Romcke et al. [22] recorded that complete sealant retention was 89% after one year and 60% after 7-9 years. Pardi et al. [23] determined that flowable resin composite as a sealant material after 24 months caused a successful retention but 4.3% carious lesions were detected.

Evaluation of QLF had given more advanced results than clinical evaluation of demineralization and plaque accumulation. In the other hand showing these demineralization areas and plaque accumulations on computer screen was a good motivation and information for the patient. Five carious teeth were determined by clinical evaluation

while 66 lesion areas in 38 carious teeth were determined by QLF. The loss of sealant materials and plaque accumulation were determined better by QLF (*Table 1*). Further *in vivo* validation is required to ensure that the intra-oral conditions do not adversely affect what appears to be an extremely useful new diagnostic aid [12].

The clinical study underlined that ormocer-based fissure sealant has been found to be a successful material with low failure rate, good retention and acceptable surface texture at 24-month clinical trials under the conditions of this study. Evaluation by QLF was more successful than clinical examinations in determining demineralization areas and plaque accumulation.

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References

1. Bayne SC, Thompson JY, Taylor DF. *Dental Materials*: In: The art & science of operative dentistry. Roberson TM, Heymann HO, Swift EJ. 2002, 4th eds. St. Louis, London, Philadelphia, Sydney, Toronto: 187-190.
2. Carvalho JC, Thylstrup A, Ekstrand K. Results after 3 years non-operative occlusal caries treatment of erupting permanent first molars. *Community Dent Oral Epidemiol.* 1992; **20**(4): 187-192.
3. Rippa LW. Sealants revisited: an update of the effectiveness of pit- and fissure sealants. *Caries Res* 1993; **27**(Suppl 1): 77-82.
4. Lundeen TF, Roberson TM. *Cariology: the lesion, etiology, prevention and control*. In: Sturdevant CM, Roberson TM, Heymann HO, Sturdevant JR (eds). The art and science of operative dentistry. 3rd ed., 1995 Mosby; 63-132.
5. Kidd EAM, van Amerongen JP. *The role of operative treatment*. In: Dental Caries. The disease and its clinical management. Fejerskov O, Kidd E. 2003; Blackwell Munksgaard; 245-250.
6. Simonsen R. Retention and effectiveness of dental sealant after 15 years. *J Am Dent Assoc.* 1991; **122**(10): 34-42.
7. Handleman S, Washburn F, Wopperer P. Two-year report of sealant effect on bacteria in dentine caries. *J Am Dent Assoc.* 1976; **93**(5): 967-970.
8. Handleman S. Effect of sealant placement on occlusal caries progression. *Clin Prevent Dent.* 1982; **4**(5): 11-16.
9. Mertz-Fairhurst E, Schuster G, Fairhurst C. Arresting caries by sealants: results of a clinical study. *J Am Dent Assoc.* 1986; **112**(2): 194-197.
10. Mertz-Fairhurst EJ, Curtis JW, Ergle JW, Rueggeberg FA, Adair SM. Ultra conservative and cariostatic sealed restorations: results at year 10. *J Am Dent Assoc.* 1998; **129**(1): 55-66.
11. van Amerongen JP, Davidson CL, Opdam NJM, Roeters FJM, Kidd EAM. *Restoring the tooth: 'the seal is the deal'*. In: Dental Caries. The disease and its clinical management. Fejerskov O, Kidd E. 2003; Blackwell Munksgaard; 275-291.
12. Pretty IA, Edgar WM, Higham SM. *A review of the effectiveness of QLF to detect early caries*. In: Stookey GK (ed): Early detection of dental caries III:

Proceedings of the 6th Indiana University School of Dentistry, 2003; SpringDot, Cincinnati, Ohio; 253-289.

13. van der Veen MH, Wolfgang B, de Josselin de Jong E. *QLF technologies: recent advances*. In: Stookey GK (ed). Early detection of dental caries III: Proceedings of the 6th Indiana University School of Dentistry, 2003; Spring Dot, Cincinnati, Ohio; 291-300.

14. Fan PL, Seluk LW, O'Brien WJ. Penetrability of sealants. *I. J Dent Res*. 1975; **54**(2): 262-264.

15. Simonsen RJ, Stallard RE. Sealant-restorations utilizing a dilute filled composite resin: one year results. *Quintessence Int*. 1997; **8**(6): 77-84.

16. Houpt M, Eidelman E, Shey EZ, Fuks A, Chosack A, Shapira J. Occlusal restorations using fissure sealants instead of "extension for prevention". *ASCD J Dent Child* 1984; **51**(4): 270-273.

17. Mertz-Fairhurst EJ, Adair SM, Sams DR et al. Cariostatic and ultraconservative sealed restorations. Nine-year results among children and adults. *ASCD J Dent Child* 1995; **62**(2): 97-107.

18. Simecek JW, Diefenderfer KE, Ahlf RL, Ragain JC Jr. Dental sealant longevity in a Cohort of young U.S. naval personnel. *J Am Dent Assoc*. 2005; **136**(2): 171-178.

19. Brova M, Liodra JC, Baca P, Osorio E. Effectiveness of visible light fissure sealant (Delton) versus fluoride varnish (Duraphat): 24-month clinical trial. *Community Dent Oral Epidemiol*. 1996; **24**(1): 42-46.

20. Boksman L, Carson B. Two-year retention and caries rates of UltraSeal and FluoroShield light-cured pit and fissure sealants. *Gent Dent*. 1998; **46**(2): 184-187.

21. do Rego MA, de Araujo MA. A 2-year clinical evaluation of fluoride-containing pit and fissure sealants placed with an invasive technique. *Quintessence Int*. 1996; **27**(2): 99-103.

22. Romcke RG, Lewis DW, Maze BD, Vicerson RA. Retention and maintenance of fissure sealants over 10 years. *J Can Dent Assoc*. 1990; **56**(3): 235-237.

23. Pardi V, Periar AC, Ambrosana GM, Menehmm Mde C. Clinical evaluation of three different materials used as pit and fissure sealant: 24-months results. *J Clin Pediatr Dent*. 2005; **29**(2): 133-137.

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