

Retention of pit and fissure sealants placed in a dental school pedodontic clinic: a retrospective study

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Abstract

The purpose of this study was to determine the combined retention rates of two Bis-GMA sealants ("Delton" and "Nuva-Seal") in a pedodontic clinic. Included in this study were 176 patients whose mean age was eleven years and five months. For all teeth examined, the relationship between the percentage of teeth with "sealant all present" and longevity is almost linear from the plotted value at six months (85%) to that at thirty-three months (67%). This corresponds to an initial failure rate of 15% followed by a failure rate of about 4% at each six-month recall exam. Retention rates have also been reported for all permanent teeth, maxillary versus mandibular permanent teeth, and premolars versus molars. The high retention rates support the use of sealants as a means of preventing pit and fissure caries in children.

Although there have been numerous studies^{1,22} that have reported on occlusal sealant retention, this study was conducted to assess the value of sealants in a pedodontic clinic where a large number of operators and assistants with varying degrees of knowledge and technical skills would use the material.

The vast majority of previous studies have used a small number (mean = 3) of professionals who were highly trained in the sealant application technique, involving up to 4,462 teeth in one study² and in excess of 3,780 in another.³ The specialization of these operators may very well have resulted in superior sealant retention rates. While clinical results obtained by trained and experienced personnel under optimal conditions are of interest, it is also important to know how well sealants are retained when applied under average practice conditions. While the conditions of this study are not typical of conditions in private practice, these results may be more representative than those research studies that had a large number of sealants placed by a few experienced clinicians.

This paper reports the results of a sealant retention study that routinely used rubber dam whenever the

teeth to be sealed were erupted sufficiently to allow its placement. Of the 20 "Nuva-Seal" and "Delton" studies reviewed, only one⁴ used rubber dam routinely. Although Poulsen and Peltoniemi⁵ found no significant difference in retention when sealants were placed on *primary teeth* with isolation by cotton rolls on one side of the mouth versus rubber dam on the other, one would expect improved retention if rubber dam were routinely used for sealant application.

Another purpose of this study is to explore the advantages and disadvantages of a retrospective sealant retention study using a dental school pedodontic population. Some potential advantages are low cost, data collection over a short period of time, and data that is representative of sealants placed throughout the year, rather than at one time. Although two studies^{6,7} were based on the placement of sealants by students in dental school pedodontic clinics, this is the first retrospective sealant retention study.

Methods and Materials

Patients receiving treatment in the Department of Pedodontics at the College of Dentistry of The University of Iowa were the subjects eligible for this study. Their dental charts were checked for previous sealant application; patients who had sealants placed five or more months earlier were included. Data was collected over a five-month period during the summer and fall of 1979.

From a very large pedodontic clinic population, 176 patients whose mean age was eleven years and five months were included in this study.

Two brands of sealants were used; "Delton,"^a an autopolymerized sealant and "Nuva-Seal,"^b an ultraviolet light polymerized sealant. For the first six months only "Nuva-Seal" was available; this was followed by the introduction of "Delton," which soon became the only brand used.

^aJohnson and Johnson; East Windsor, NJ.

^bThe L. D. Caulk Company; Milford, DW.

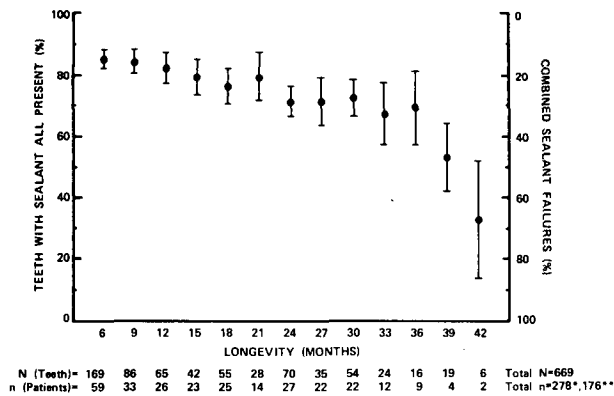


Figure 1. Sealant retention on all teeth examined at 5-43 months.

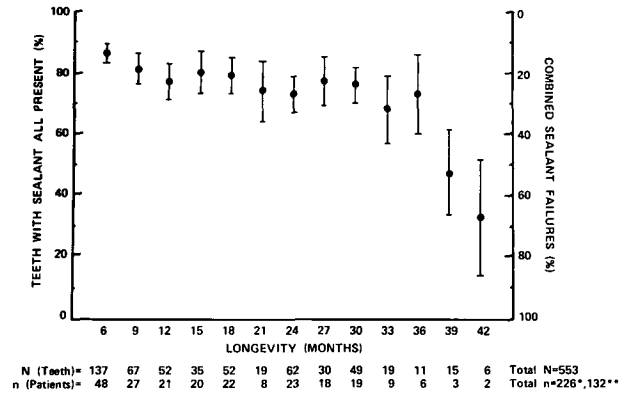


Figure 2. Sealant retention on permanent teeth examined at 5-43 months.

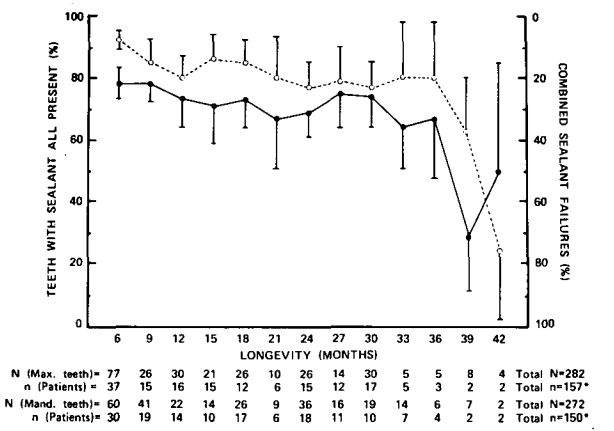


Figure 3. Sealant retention on maxillary (o) versus mandibular (•) permanent teeth examined at 5-43 months.

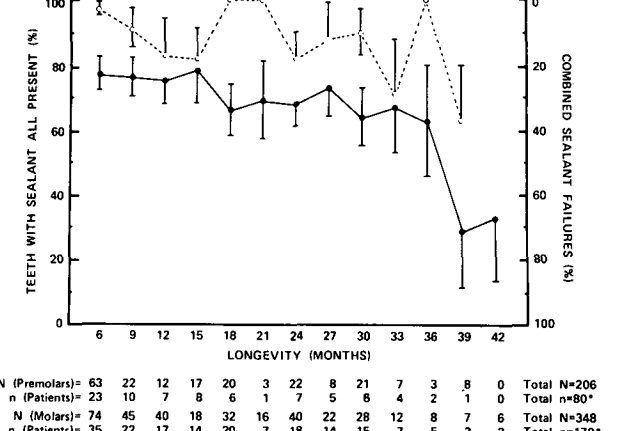


Figure 4. Sealant retention on premolars (o) versus molars (•) examined at 5-43 months.

As the brand of sealant used was not routinely recorded on the patient's chart, the percentage that are "Nuva-Seal" and "Delton" is not known.

The charts of all potential subjects were screened to determine if a given patient met the criterion of having had a sealant placed at least five months earlier.

If the sealant was "all present" or "partly missing," the status was recorded on the data collection form.

All subjects were examined by one examiner (R.A.A.) with a plane, number 4, front-surface dental mirror and a sharp, number 23, explorer. The teeth were air-dried and a high-intensity dental light was used for illumination.

On the few occasions when there was doubt as to whether a sealant was "all present" versus "partly missing" or "all missing" versus "partly missing," the status that was consistent with sealant loss was selected. This was done to be sure that the results reported were not an overstatement of the true retention rates.

Results

The total of the number of patients seen in the 13 time intervals is 278 (as opposed to the actual number of 176) because some subjects had sealants placed

on two or more occasions.

Figures 1 through 4 show graphically the percentage of teeth with "sealants all present" (and the corresponding percentage of combined sealant failures) for each of the 13 three-month time intervals. The only statuses about which a definite statement can be made are "sealant all present" and "sealant partly missing;" both were determined at the time of the clinical examination. Only the values for "sealant all present" were graphed. All other values represented sealant failures, of one form or another, and were combined and graphed as "combined sealant failures." Each figure reports the number of teeth and the number of patients examined for each time interval. The total number of teeth and the total number of patients examined for all time intervals are also reported.

Figure 1 shows sealant retention on all teeth examined at 5 to 43 months. The relationship between the percentage of teeth with "sealant all present" and longevity is almost linear from the plotted value at 6 months (85%) to that at 33 months (67%).

The last three values (for 36, 39, and 42 months) represent only "Nuva-Seal" sealants, while the previous values represent a combination of "Nuva-Seal" and "Delton" sealants.

Consistent with a decrease in the number of patients as a function of greater longevity is the general increase in each standard error of the mean (hereafter abbreviated SEM).

Sealant retention at six months ranges (for one SEM) from a low of 82% to a high of 88% and thereafter, results in combined failures of about 4% at each six-month recall exam.

For all patients who met the criteria of the study, the mean number of teeth sealed per patient was 3.8 (669 teeth were sealed on 176 patients).

Figure 2 shows sealant retention on permanent teeth examined at 5 to 43 months. Ignoring the last three plotted values (for "Nuva-Seal" only), the relationship between the percentage of teeth with "sealant all present" and longevity is almost linear from the plotted value at six months (86%) to that at 33 months (68%).

Sealant retention at six months ranges (for one SEM) from a low of 83% to a high of 89% and thereafter, results in combined failures of about 3% at each six-month recall exam.

For all patients who met the criteria of the study, the mean number of permanent teeth sealed per patient was 4.2 (553 teeth were sealed on 132 patients).

Figure 3 shows sealant retention on maxillary versus mandibular permanent teeth examined at 5 to 43 months. Ignoring the last three sets of plotted values (for "Nuva-Seal" only), those for maxillary teeth (circles) and mandibular teeth (dots) show similar (almost linear) relationships, although sealants were found to be better retained by maxillary teeth. Loss over time does not appear to be different for maxillary versus mandibular teeth.

The only reversal occurred at 42 months (in the "Nuva-Seal" only group) where the lowest number of teeth were examined in both the maxillary (four teeth on two patients) and mandibular (two teeth on two patients) groups.

Figure 4 shows sealant retention on premolars versus molars examined at 5 to 43 months. Ignoring the last three sets of plotted values (for "Nuva-Seal" only), those for premolars (circles) and molars (dots) show similar (almost linear) relationships, although sealants were found to be better retained by premolars. Loss over time does not appear to be different for premolars versus molars. Sealant retention appears to be superior on premolars.

Because the SEMs were so large and the plotted values so erratically distributed, the sample size for primary teeth examined is believed to be too small to draw any conclusions with respect to sealant retention. Only 115 primary teeth on 44 patients met the criteria of this study and a poor distribution resulted in most data representing the early months.

Discussion

With respect to sealant retention on all teeth examined, it is believed that an almost linear relationship has been shown between the percentage of teeth with "sealant all present" and time (Figure 1). This relationship was previously demonstrated by Going et al.⁸

After the first six-month recall, where a high failure rate occurs probably because of faulty technique, failures are due to occlusal wear, proximal caries, extraction due to orthodontics, or exfoliation. Of these, the only true sealant failure would be "occlusal wear," which is consistent with a linear relationship.

In terms of the six-month recall program, at each recall, about 4% of the sealed teeth that are examined have failed for one reason or another. Failures due to partial or total sealant loss would be rectified by resealing the teeth. A very small percentage of failures (occlusal or proximo-occlusal caries) would have to be dealt with in another manner (alloys, stainless steel crowns, etc.).

The better retention of maxillary teeth compared to mandibular is confirmed by Burt et al.⁹ and Whitehurst and Soni.¹⁰ McCune et al.¹¹ found no difference and several authors reported superior retention for mandibular teeth.^{6,8,12-14} The superiority of mandibular teeth is surprising, as none of the studies reporting this routinely used rubber dam. One would expect an increased likelihood of salivary contamination due to pooling and/or tongue movements.

With respect to this study, possible explanations as to why the difference between maxillary and mandibular retention rates was so small may be that rubber dam was used so extensively and that the distolingual groove on maxillary molars was not considered. Looking at it another way, one could speculate that the reason the results were not equal was due to a failure of the rubber dam to adequately protect the teeth from salivary contamination plus the fact that rubber dam could not always be used.

The reason that the plotted values are less linear than in the figures for all teeth examined, and permanent teeth examined can be explained simply by the fact that the sample size, already too small, was cut in half (Figure 3).

Figure 4 shows the superiority of premolars compared to molars with respect to sealant retention. The better retention rate for premolars is confirmed by many previous studies^{4,6,8,9,13,15-17} and is most likely due to: less occlusal force, improved isolation with less chance of salivary contamination, better access for application, improved patient cooperation due to later eruption time (except for second molars), or a combination of the above.

A consideration of the various kinds of sealant

failures is in order. Failures can take four forms:

1. Failures due to poor technique at the time of placement (e.g. salivary contamination, not sealing all pits and fissures, inadequate rinsing or drying, insufficient etching time, etc.).

2. Failures due to the sealant material itself (e.g. poor wear resistance, inability to wet the tooth's surface, too rapid a setting time, coefficient of thermal expansion not compatible with enamel, etc.).

3. Non-sealant-failures (e.g. proximal caries, extraction for orthodontic reasons, or exfoliation).

4. Failures due to a combination of the above.

With respect to the six-month results (the time interval with the largest number of subjects):

1. One percent of the teeth examined had their sealants completely missing. These are probably technique failures and occurred soon after placement. One would not expect sealants to be completely worn away in such a short period of time.

2. Four percent of the failures were due to part of the sealant being "lost." Again, wear should not have taken place this soon; these failures are also probably due to faulty technique. A spot check of sealants that were placed just minutes earlier revealed many that were "partly missing." A tooth would have been judged, six months later, to have "lost" part of its sealant when, in fact, the sealant was never placed in all pits and fissures.

3. Failures in the "occlusal alloy present" status totaled 4%. As caries take a period of time to develop, most likely these sealants were lost very early and the failures should be attributed to faulty technique rather than a shortcoming on the part of the sealant materials.

4. Most failures in the "proximo-occlusal allow present or indicated" status group (2%) are probably due to caries on the proximal surface only. These are not "true" sealant failures and should not be counted as failures other than the fact that there is no guarantee that the occlusal surfaces didn't have simultaneous "true failures." After the alloys are placed, the occlusal evidence is gone and one can only guess as to what were the statuses of the occlusal sealants.

5. Three percent of the teeth are in the "tooth resealed" status and are probably the result of poor technique in which either all or a part of the occlusal surface was not properly sealed. Many of these failures (and those in previous groups) may reflect the poor clinical skills of some operators who attempted to seal teeth that were not erupted enough to use a rubber dam. The fact that no occlusal caries occurred in this time interval suggests many of the teeth that were resealed were due to partial sealant loss, rather than complete loss, and the remaining sealant provided caries protection during this period

of time.

6. One percent of the "failures" were due to extraction or exfoliation. Again, these are not true sealant failures but are counted as such because the condition of the sealants on the teeth that were lost was not known.

7. To summarize, because it was so soon after placement and because so many sealants were "all present" (85%), most sealant failures at the six-month exam are believed to be due to poor technique rather than a defect in the sealant material.

The low incremental rate of loss subsequent to the six-month recall (two percentage points for each three-month time interval) is more consistent with occlusal wear, proximal caries, and tooth loss than to poor sealant formulations that would have led to a much higher percentage of failures at each of the three-month time intervals.

Thus, the initial high failure rate (six-month) is explained on the basis of poor application technique and the subsequent low incremental rates on the basis of occlusal wear, proximal caries, and tooth loss.

The results of this study have been compared to other studies and are graphically displayed in Figure 5. Comparisons should be made with caution as each study was done under different circumstances and with diverse and sometimes unknown variables. Figure 5 shows some studies that reported for permanent first molars and others that reported for all permanent teeth. Those reporting only permanent first molars were included to offer a larger number of studies for comparison. The results of this study compared favorably with other studies.

Conclusions

1. Even though this study was retrospective and cross-sectional, other than some limitations, the results are similar to those reported by the majority of previous studies that were prospective and longitudinal.

2. The sealant retention rates were quite high. An almost linear relationship has been shown between the percentage of teeth with "sealant all present" and time for each six-month recall exam.

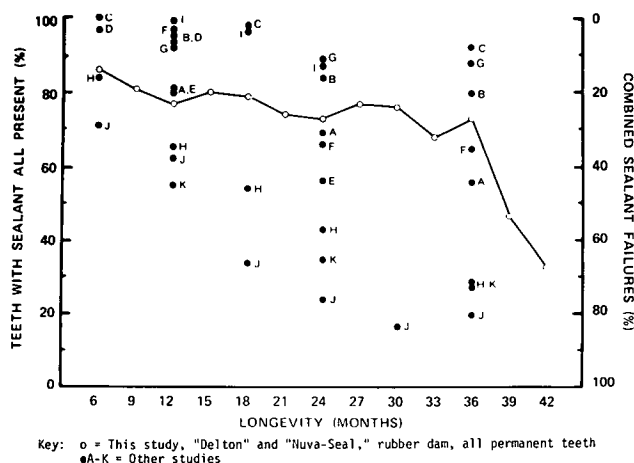
3. The failure rate for all permanent teeth is about 3% for each six-month recall exam.

4. Maxillary teeth were superior to mandibular teeth with respect to sealant retention but the difference was not statistically significant.

5. Premolars were superior to molars with respect to sealant retention but the difference was not statistically significant.

6. For primary teeth examined, the sample was too small and poorly distributed to draw any conclusions.

7. Most sealant failures at the six-month exam are believed to be due to poor application technique.



- A = Alachua, Florida;⁸ "Nuva-Seal," all permanent teeth
B = Augusta, Georgia;¹⁸ Reporting only "Delton" results, permanent first molars
C = Espoo, Finland;¹⁶ "Nuva-Seal," permanent first molars
D = Jersey City, New Jersey;¹⁹ "Delton," permanent first molars
E = Kalispell, Montana;¹³ "Nuva-Seal," all permanent teeth (unpaired)
F = Lexington, Kentucky;⁴ "Nuva-Seal," rubber dam, all permanent teeth
G = Medellin, Columbia, South America;¹¹ "Delton," permanent first molars
H = Ontario, Canada;²⁰ "Nuva-Seal," permanent first molars (combined)
I = Rochester, New York;²¹ "Nuva-Seal," all permanent teeth
J = St. John, U.S. Virgin Islands;²² "Nuva-Seal," all permanent teeth
K = Ypsilanti, Michigan;¹⁵ "Nuva-Seal," permanent first molars (2nd grade)

Figure 5. A comparison of the sealant retention rates of permanent teeth in this study with those of other studies.

8. Most sealant failures after the six-month exam are believed to be due to occlusal wear, proximal caries, and tooth loss.

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The opinions or assertions expressed herein are those of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

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