Sealants and preventive restorations: review of effectiveness and clinical changes for improvement

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Abstract

Sealants are effective caries-preventive agents to the extent they remain bonded to teeth. Preventive resin restorations (PRR) have a proven record, but are susceptible to failure as the overlying sealant fails. Careful analyses of studies reveal a measurable failure rate of sealants (5-10% per year) that must be addressed. Even under the best of circumstances, sealants fail. Therefore, dentistry (as well as third-party systems) must accept that sealants need vigilant recall and proper preventive maintenance. In addition, it is clear that cost-effective use of sealants will involve selective application on teeth with the greatest caries risk. Caries risk analysis of the patient as well as the tooth is an essential step in the treatment planning process. To improve sealant success, new material advances are suggested. Data from studies using an intermediate layer of dentin bonding agent between etched enamel and sealant show dramatic reduction of failure for sealants, particularly in instances of molars judged difficult to seal due to early stage of eruption (Pediatr Dent 20:2 85–92, 1998).

It is a daunting task to speak or to write about dental sealants after all that has been previously reported on this topic. Most dental professionals have determined their stand on sealant use. Like good religious zealots, each can quote studies that support only their side of the argument and can quietly dismiss the rest.

In the face of such a challenge, this paper offers a review of sealant failures and sealant effectiveness. From the review come suggestions for improved decision-making and more vigilant maintenance that will lead to an enhanced future for sealants and PRRs. In addition, the author offers a change in sealant technique to increase clinical success with sealants. The technique change follows from a large-scale clinical study of difficult-to-seal teeth.

This is not an exhaustive review of the sealant/PRR literature, rather a focused one. For a contemporary review of sealants and methodology, I suggest the excellent paper by Waggoner and Siegel.[1] An excellent review of the issue of effectiveness was reported by Weintraub.[2]

Sealant use

Dental sealants can be an effective preventive measure against pit and fissure decay. When placed with care and then routinely maintained, sealants represent an exceptional preventive service.[3] Nonetheless, many dentists express frustration with sealants or a distrust for the long-term benefit of this treatment. In fact, utilization of sealants has long disappointed advocates of their use. National survey data from 1988–91 show that less than 20% of US children have any sealants.[4] There may be many reasons for poor utilization of sealants. Early in the history of sealant advocacy, it was assumed that a lack of information transfer plus a skepticism of etched bonding methods contributed to low sealant use.[5] Now, with better dissemination of knowledge about sealants and a natural progression of clinician confidence with bonded materials, these reasons should not be significant deterrents to use. Adding to residual effects of the attitudes just mentioned, other factors play a role in discouraging some clinicians from prescribing sealants. Two such factors are an "in the trenches" clinician's perspective that sealants often do not satisfy the profession's need for perceived certainty with treatment[6] and a common third-party payment perspective that penalizes the clinician for necessary sealant repair or replacement.

The sealant/PRR spectrum

Management of pit and fissures for caries prevention and/or caries restoration has become a complex topic in contemporary dentistry, a topic involving the confluence of data from diverse areas of investigation such as dental materials, diagnostics, caries epidemiology, microbiology, and remineralization. Debate continues as to the best and most appropriate methods to diagnose caries in pits and fissures. In addition to that diagnostic debate, questions remain about the best therapy and/or treatment for those fissures with or without caries.

Treatment planning of what was once considered a "simple" sealant now involves a series of decisions involving risk assessment of the patient, tooth, and surface. In addition, performing the service of a sealant causes the astute practitioner to make decisions on how to prepare the fissure (if preparation is at all indicated), what bonding agents to use, what sealant to use, how to place the sealant, and how to maintain the sealant.

Sealant and PRR do not represent the only techniques available for management of the pits and fissures of teeth. A variety of methods exist, including no treatment until frank cavitation. A recent article by Croll and Cavanaugh[7] lists and illustrates six clinical approaches, one being a conventional sealant and five being variations on the PRR technique depending on depth into enamel or dentin and on the caries risk of the surface.

Philosophies of practice vary. Many modern practitioners are less quick to fill or seal pits and fissures, as caries prevalence and caries rate have slowed considerably, even on these surfaces. And it is important to acknowledge this "watch and wait" philosophy for questionable lesions. Regular observation prior to making a treatment decision is worthy of additional study as analysis of the latest national surveys of caries rates by surface shows occlusal surfaces having the greatest decrease in actual caries numbers.[8] Obviously, some of the recent decrease in caries on these surfaces relates to the disproportionate amount of caries still found on occlusal surfaces. Nonetheless, pit and fissure caries is decreasing in real numbers. The carious attack is less prevalent on those surfaces, and caries progresses less quickly.

Tooth surfaces that warrant sealant coverage still confront the clinician with long-term treatment decisions. The science behind these decisions demands additional attention by our profession.

Evaluation of sealant loss and partial loss

Buonocore first reported that bonding to tooth surfaces was possible.[9] Further work showed remarkable success, unexpected by a profession previously familiar only with restoratives dependent upon mechanical retention. It truly was news that we could bond to tooth. The surprise was that any of the early polymers stayed in place. The first adaptation of the etch technique to fissures was reported in 1967,[10] and the profession was amazed when studies reported appreciable sealant retention.

Investigators and readers were likely to think of any retained sealant as a success, because they did not really expect all of the sealant to stay in place anyway. Therefore, the profession entered into sealant investigations with a crude and probably overly optimistic criteria for success. In most people's minds, partial retention of sealant on an occlusal surface was often considered "success".

With the perspective of two decades of sealant studies to guide us, we can now see that this overly optimistic evaluation was incorrect. Partial loss of sealant is still an unresolved issue in sealant studies. What we do know is that there is a range of conditions we may judge as "partial loss" or "partial retention". Some of these may be successful sealants, while others are clear failures. Data from past studies have made the case that any appreciable "partial loss" of sealant leaves a tooth equally susceptible to caries as an unsealed control tooth.[11, 12]

It is also important to remember that all sealants exhibit partial loss in the strict sense of the term, because all show reduced volume over time. Elegant work by Conry and coworkers,[13, 14] using a computer-driven profilometer, has documented the extent of sealant area and volume change on sealants in vivo. So, sealant loss of some type is continuous. Clinically significant changes occur when sealants have lost enough material to leave a deep fissure uncovered or when sealants fracture, leaving a sharp margin with the remaining tooth, as these defects often lead to eventual caries.

Short of frank caries development, there exists no strict definition of what constitutes a failed sealant. While the scientists may debate the issue, the clinician makes daily decisions on when to repair and when to

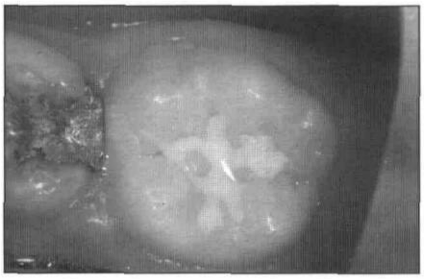

Fig1. White sealant on a mandibular first molar. The buccal sealant and the bulk of the occlusal sealant are intact and "successful". Sealant loss has occurred leading to several supplemental grooves of the occlusal surface being exposed and stained. No primary groove is uncovered. No caries are detectable.

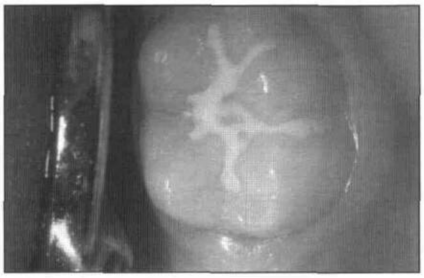

Fig 2. White sealant on a mandibular first molar. All aspects of this sealant are intact with the exception of the most lingual part of the lingual occlusal fissure. No caries are detectable.

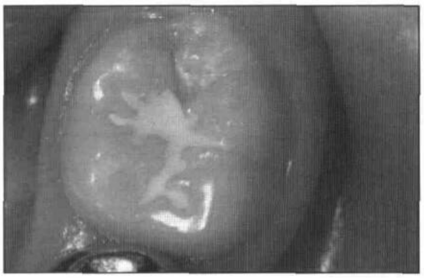

Fig 3. White sealant on a mandibular first molar. The distal one-third to one-half of this sealant has fractured and debonded. A major defect is present at the sealant-tooth margin and two primary grooves are uncovered.

leave alone. Examples of the difficulties of judging sealant failure can be seen in Figs 1–3. Which of these sealants are failures and which are continuing successes? Each of these sealants shows loss of material compared with the original placement, so they should be recorded as partial loss. But which of them are clinical failures? The tooth in Fig 1 has lost material but has not uncovered any fissure anatomy. Fig 2 has lost material over only one small fissure area. Fig 3 shows a sealant with half the originally covered fissure anatomy now open to caries attack.

Partial loss of sealant is a provocative issue because it affects judgment of sealant success and effectiveness. Clearer definition of the important (clinically relevant) partial losses would go far to determine need for preventive maintenance of sealants.

It is informative to re-evaluate past data regarding sealant success in the light of our contemporary questions. Some sealant studies have carefully reported retention by tooth type and surface. Those detailed reports offer another glimpse at the issues of sealant effectiveness. While many review articles and symposia concerning sealants report only summary data from these studies (due to the overwhelming volume of sealant data), a close look at some detail is in order.

One example is the classic work by Going, Haugh, Grainger, and Conti,[15] "Four-year clinical evaluation of pit and fissure sealant." This excellent study included paired control "nonsealed" teeth with experimental sealed teeth, and it carefully reported success status for each tooth type and surface, as well as caries status of sealed and nonsealed teeth. The article contains a wealth of information. Yet, this reference is often cited or summarized as "The sealant was fully retained on 50% of all paired permanent teeth at 48 months." This summary does not tell the full story.

In the article, there is a breakdown of data by tooth type. Sealant retention is listed as "all present" on 50% of all teeth, 64% on premolars, and 29% on molars. "Partly missing" data are 28% of all teeth, 21% on premolars, and 40% on molars. This leaves sealant "all missing" on 22% of all teeth, 15% of premolars, and 31% of molars.

Comparing caries rates on treated and control sides of the mouth leads to the following data on percent effectiveness: All teeth—43%, Premolars—84%, and Molars—30%.

This discussion is not a criticism of Going and coworkers, as they report all the details openly in their paper and as other sealant studies have a similar magnitude of failure, but this is an important discussion because we need a critical, realistic view of sealant success now. Therefore, we need to look more deeply into the data than simply reporting the mean values. Our early views of sealant success or failure were unrealistically brightened by two factors: first, the averaging of success on tooth types (molars and bicuspids), and second, by assuming that presence of any sealant on the surface was a success.

Because it's easy to see that bicuspids have better sealant retention scores than molars in the Going et al.[15] paper, and as molars are the teeth most in need of caries prevention, I will limit additional literature citations to those papers that give data on permanent molar sealants or offer long-term evaluations of success.

A 7-year study by Mertz-Fairhurst and colleagues[12] reported on two products, autopolymerizing Delton® (a second-generation sealant) and UV-polymerized Nuvaseal® (a first-generation sealant). This was at the end of the Nuvaseal era, as the Delton and other similar generation products were proving more effective. So, looking only at the more favorable Delton data, this report shows that after 7 years, first permanent molars had 66% sealant retention while partial retention was 14%. Total sealant loss was 20% and, comparing caries rates on the sealed half of the mouth with the nonsealed control half, caries reduction effectiveness was 55%. That means that 32 of the treated teeth were carious and 71 of the control teeth were carious after 7 years. Data from both materials showed that partial retention of sealant did not automatically guarantee protection. Caries rates on molars with partially retained sealants (by the authors' definition) were equal to caries rates on the contralateral control teeth.

Barrie et al.[16] compared three sealant types in 5- to 6-year-old Scottish children. In this more contemporary field study, occlusal sealants were judged "completely sealed" in two comparative subsets of patients. In the first, Prismashield® was compared with Estiseal® and 24-mo retention was 71% for Prismashield, with 53% for Estiseal. The other comparison group had 24-mo retention of 81% for Prismashield and 88% for Concise.

On review of these studies, as well as review of other published sealant data and recent IADR abstracts, one could conclude that the expected sealant loss from permanent molars is between 5 and 10% per year. In addition, because caries risk returns after sealant loss, it's suggested that the caries rates for sealed teeth reflect the 5–10% loss multiplied by the usual population caries rates for pit and fissure surfaces.

The value of sealant upkeep

Other studies indicate better success. On closer evaluation, these studies often report data from a population in which the sealants are regularly maintained. Regular maintenance was not a part of the study protocol in the previously cited clinical studies. Therefore, reports that include recall and maintenance offer important information on the value of regular upkeep of sealants.

Romcke and coworkers[17] report a 10-year observation of more than 8000 sealants placed on first permanent molars in an annual dental care program on Prince Edward Island, Canada. Complete sealant retention, without need for resealing, was 41% at 10 years, and 58–63% for 7 to 9 years. This agrees with the previously stated concept of 5–10% of loss each year. Patients in this study were seen yearly and sealants were annually repaired as necessary. One year after insertion, 6% of sealants required maintenance. After the first year following placement, the maintenance needs dropped to 2–4% each year. In light of a vigilant annual recall and repair program, these authors can report sealant success (freedom from caries) of 96% for the first year and 85% after 8–10 years.

A study of sealants on first permanent molars in Sweden by Wendt and Koch[18] indicates a similar follow-up model. The authors state that sealants were "controlled" once a year. The 758 sealed surfaces were followed for 1–10 years, and the resulting examinations showed 80% total sealant retention after 8 years. Another 16% of the surfaces were judged as partial retention. After 10 years, only 6% of the sealed occlusal surfaces showed caries or restorations.

Another more recent report strengthens the argument that sealants need regular maintenance. Chestnutt et al.[19] reported on more than 7000 sealants applied by private practitioners in Scotland. After 4 years (during which time it is assumed that normal recalls and regular dental care continued), 74% of the sealed tooth surfaces remained fully sealed and 18% were scored as deficient or failed sealants. Of the surfaces originally scored as deficient sealants, 23% were scored as carious 4 years later. This compared with a 21% caries rate on surfaces originally scored as sound but not sealed. Sealed surfaces showed a caries rate of only 14.4% during the 4-year period. Conclusions from these data suggest that deficient sealants are not effective in caries prevention, arguing for continued follow-up of the originally sealed surfaces at every recall visit. Maintenance of sealants is vital for success over the long term.

Practitioner reports

Clinicians are often skeptical of data from large clinical studies, feeling that the results are not representative of their own experience. Regarding sealant success, private practice reports confirm that even detail-oriented operators struggle with sealant failures. Dr. Dan Shaw, a Board-certified pediatric dentist from Eden Prairie, Minnesota, has kept personal records of sealants in his practice for the last 10 years.[20] His data will be submitted for publication soon. All sealants were placed by him with the help of a chairside assistant. Patients in his practice who have been treated with sealants show sealed surfaces 90% caries-free after 5 years, with 6% of the surfaces requiring resealing and 4% requiring restorations. At 8 years, the numbers are 61% caries-free, with 24% resealed, and 15% restorations. Again, in this data set approximately 5% of sealants needed additional maintenance or restoration each year.

Based on the reported sealant data, we must be realistic in our own expectations and in the way we market sealants to the public. Sealants need continuing care, and this maintenance must be factored into the real and perceived costs of sealants.

Diagnoses—which teeth to seal?

The need to be realistic about sealant retention and effectiveness logically leads to a need for diligence in the decision to seal. If cost effectiveness is the main factor in this decision, one must carefully choose where to put sealants.

In a recent report by Heller et al.,[21] an important comparison was made. By fortuitous circumstances of the study, some of the patients originally evaluated for the study did not enter the sealant application portion of the study. The patients who did not receive sealants were all rescreened after 5 years, along with the sealant-application subjects. This afforded the examiners an opportunity to compare caries rates on teeth in both sealed and nonsealed subjects. An additional advantage of the study is that the examiner scored molar surfaces as "sound" or "incipient" at the original screening appointment. Therefore, the investigators were able to report subsequent 5-year caries rates on teeth originally scored as incipient, as well as those originally scored as sound. The results are most intriguing. After 5 years, molars scored initially sound became carious at a rate of 13% in the nonsealed cases and 8% in the sealed cases. This difference (13 to 8%) is a modest caries protective effect. Alternatively, after 5 years, molars initially scored as incipient became carious at a rate of 52% in the nonsealed cases and only 11% in the sealed cases. This difference (52 to 11%) is striking.

The data from Heller's study argues that if we were able to effectively rate teeth as "at risk" and concentrate our sealant efforts on these, the caries preventive effect of sealants would be extremely significant. Dentistry is presently struggling with methods of caries risk assessment for patients. It is clear that better sealant success would follow better risk assessment of the patient, the tooth, and the surface. This risk-associated decision to seal has been advocated since some of the early sealant studies,[11] but it continues to be an issue of contention.

Can we agree on criteria to rank patients on caries risk? Possibly not. Can we agree on criteria for tooth surfaces at risk? Maybe, although our perception of such a simple judgment as "deep occlusal anatomy" varies from practitioner to practitioner. At least we should agree that each practitioner make an initial assessment of risk, using their own personal criteria, prior to treatment planning for sealants.

Tooth choice and cost-effectiveness of sealants

Determination of sealant effectiveness has been done on populations that were part of a sealant project[8] and by comparing caries-rate survey data with sealant-retention data.[22, 23] It is clear that sealants save surfaces from becoming carious if the sealant stays in place. But the number of sealants that need to be placed in order to prevent one surface's restoration is important to keep in mind. In populations with average caries rates, it has been calculated that 5–10 sealants must be placed to save one molar surface from becoming carious. In bicuspid teeth, which have lower overall caries rates than molars, the numbers are closer to 25–40 (in some computations up to 100) sealants placed for every surface saved. Teeth most at risk for caries will therefore show the best effectiveness numbers for sealant applications. As the caries rates decline, the effectiveness values decline.

One should note that cost-effectiveness computations often assume 100% sealant retention. That is never the actual case. Contemporary sealant studies show caries increments on teeth originally sealed for the study. For example, Mertz-Fairhurst and coworkers[12] in their 7-year study in Augusta, Georgia, had a mean sealant retention rate of 66%, but a caries incidence of 10% and a percentage effectiveness of 55%. Therefore, the number of sealants to be placed in order to save a single surface from caries is larger than previously calculated in most cost/benefit computations.

It is important to target sealants to the most susceptible surfaces of the most susceptible teeth. A complication of this philosophy is that these teeth and surfaces are often the most difficult to successfully seal, leading to high rates of failure.

Difficult-to-seal teeth

Newly erupted molars

One example of caries susceptibility combined with sealant difficulty is the newly erupted permanent first molar. This tooth is commonly carious within 2 years of emergence through the tissue. In fact, many first permanent molars have fissures that are questionable or that are diagnosed with incipient caries as they erupt. The difficulty for the practitioner involves how to protect this at-risk or "sticky" fissure prior to full eruption. Dennison and coworkers[24] reported in 1990 that sealants placed on molars early in eruption were far more likely to require replacement within 3 years. At a stage of eruption in which the distal tissue is at the level of the distal marginal ridge, the replacement rate for sealants was 26%. At an eruption stage when a tissue operculum existed over the distal marginal ridge, the sealant replacement rate was 54%. In comparison, this group of investigators found 0% replacements necessary for a sample of sealants placed at later stages of eruption.

The practitioner may choose to seal the susceptible molar at an early stage of eruption, thus affording the tooth the best of preventive care. Yet, this practitioner may be at risk for personally funding the necessary sealant replacement in the near future.

Buccal pits and lingual grooves of molars

Two other areas of susceptibility and sealant difficulty are buccal pits and lingual grooves. Relatively few studies report data on buccal and lingual pits and grooves, yet these anatomical areas on molars account for a significant portion of all pit and fissure decay. Data from national surveys show that buccal pits of mandibular first molars and lingual grooves of maxillary first molars contribute a significant number of carious lesions to the overall caries rates for those teeth. From the 1987 National Caries Survey by the National Institute of Dental Research (NIDR), buccal surfaces of mandibular molars contributed about 40% of the total caries on that tooth while lingual surfaces of maxillary molars contributed about 30%.[8] Anecdotally, clinicians find it difficult to place successful sealants in buccal and lingual fissures. This perspective is evidenced by the decision by many to avoid sealing these surfaces due to the frustration of early sealant loss.

The report by Barrie et al.[16] on Scottish 5 and 6 year olds is one of the few recent studies that gives sealant data on buccal and lingual surfaces. Two years after initial application of the Prismashield and Concise sealants, 39 and 35% of buccal and lingual surfaces were judged "completely sealed". These numbers are significantly lower than the occlusal sealant success of 81 and 88%, respectively, for the two materials in the same study.

Clearly, the buccal and lingual surfaces are more difficult to protect than are the occlusal surfaces. Instead of losing 10% of occlusal sealant per year, investigators often lose 30% of the buccal/lingual sealants per year.

Improvements based on material and technique changes

Newer materials may help reduce the risk of early failure in difficult-to-seal teeth. My research has focused on this type of need. Use of an intermediate bonding layer between enamel and sealant has been shown effective in the face of major saliva contamination in our previous lab studies[25–27] as well as a clinical study.[28] Therefore, we know that in controlled situations, sealant sensitivity to moisture contamination can be virtually eliminated by the careful use of this method. In these studies, bond strength of sealant to enamel is increased[25, 26] and microleakage at the sealant/enamel margin is reduced[27] in teeth with bonding agent plus sealant compared to control teeth with sealant only. Others have confirmed these findings of bond strength improvements.[29]

From our previous studies it is clear that on clinically dry teeth, the bond remains excellent using the intermediate bonding agents. Therefore, we are teaching this bonding agent layer as a normal feature of all sealant applications.

Another ongoing clinical study, briefly described, involves taking patients whose teeth have been judged "difficult to seal" and comparing long-term sealant effectiveness between one side of the mouth that is sealed with normal sealant technique, as described by manufacturer's specifications, and the other side that is sealed with the addition of an intermediate bonding agent between the etched enamel and the sealant. Sealants are scored at each recall using strict criteria for marginal integrity, marginal staining, and anatomic form. The condition of the sealant is recorded at every recall visit with the use of an intraoral video camera.

We are able to significantly decrease failures of sealants on early erupted molars and on buccal/lingual sites by adding of a bonding agent onto the etched-enamel surface, air thinning that agent, and then placing the sealant.[30, 31] Fig 4 is a representative graph of data of the first year of experience in two study groups—with and without Tenure® primer as an intermediate bonding layer below the sealant on approximately 240 sealants. Sealant failure (by our strict study criteria) on buccal and lingual sites at 12 months was 28% for control teeth (sealant only) and 10% for the bonding agent/sealant group. Similar improvement is seen in occlusal sealant success. Four-year data on these study cohorts are being analyzed for publication. The 1-year differential in failure rate between the two groups as shown in Fig 4 continues through the observed 4 years of sealant wear.

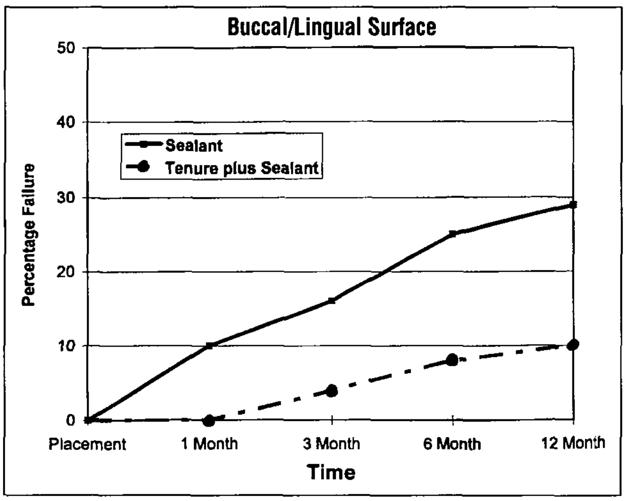

Fig 4. This graph shows buccal/lingual sealant failure in one representative study group on more than 200 sealants over the first year of the study. Circles represent the percent failure of the buccal/lingual sealants on teeth sealed with the intermediate bonding agent (Tenure primer in this group) plus sealant. Squares represent sealant failure on teeth sealed with sealant alone. Differences are statistically significant at all time points.

Other bonding agents have also shown significant benefit. Prime and Bond® as an intermediate agent (tested as our newest cohort to reach 12 months) reduces failures even more than does Tenure. Of the 38 control teeth, 9 (24%) occlusal sealants have failed while only 5 (14%) occlusal sealants with Prime and Bond have failed at 12 months. For buccal and lingual sealants in the Prime and Bond groups, the numbers are 11 failures out of 32 controls (34%) and only 2 failures out of 30 (7%). From this study, we conclude that reductions of one-third of occlusal sealant failures and one-half of buccal/lingual sealant failures are possible. One small addition to the normal technique makes our sealant method demonstrably better.

Other improvements are afforded by the bonding agent, in addition to the improved retention of the sealant. These have been reported by clinicians using the bonding-agent method in practice. In an attempt to make sealants that are more resistant to occlusal wear, more highly filled sealant has been produced. Some of these are thick and viscous, causing difficulty in spreading into small fissures. The bonding agent step aids the placement of these viscous materials. The sealant spreads better after bonding agent placement, and wets the surface of the fissures better.[32] The result is a filled sealant that is more resistant to wear, which has deeply penetrated all the necessary fissures.[33]

Benefits of the intermediate bonding agent layer are:

1. better bond strength and less leakage in potentially wet areas[25–27, 29]
2. improved retention[28, 30, 31]
3. better flow of viscous sealant material on the tooth surface[32, 33]

The bonding agent technique advocated here offers additional advantages in chemical technology to aid the practitioner. Hydrophilic agents in the adhesive system overcome inadvertent moisture contamination, while the adhesive system itself serves as the low-viscosity, flowable wetting agent for the interface between etched enamel and the filled resin.

The bonding agent step is one example of material-based improvement. More advances can be expected from materials scientists in the near future. The exciting aspect of improving our sealant materials is the potential benefit in cost effectiveness. With more sealant staying in place, the effectiveness data will improve. In addition, clinician judgment about where to use sealants and when to seal may be broadened, so that ultimately, those surfaces most susceptible to decay could have the benefit of early sealant.

Preventive resin restorations

A logical extension of preventive sealant strategy involves use of resin restorative materials plus sealant to restore tooth material lost in discrete areas of caries attack on a fissured surface. First reported by Simonsen and Stallard,[34] this 20-year-old concept has gained wide approval. The procedure involves use of the dental handpiece to remove only those areas of the tooth affected by caries, followed by bonding resin restorative material into them, and finally covering all restorative material and any remaining fissured anatomy with sealant. The obvious saving of tooth structure is significant. By avoiding the old philosophy of "extension for prevention" tooth preparation and replacing it with the idea of discrete removal of caries, there is a major reduction in intracoronal preparation and tooth structure loss.

Many in vitro and clinical studies show that the preventive resin restorations score well compared to the single surface amalgam restoration.[35-38] Long-term clinical comparisons of PRRs with traditional amalgam restoration of these surfaces are limited to a few studies, two of which are cited here.

Welbury and coworkers[35] reported on a British population in which paired molars were restored with amalgam or PRR. During a 5-year trial that looked at 174 pairs of molars, 11 amalgams failed and eight PRRs failed. Survival statistics determined mean survival time for amalgam to be 61.5 mo and PRR to be 63.3 mo.

Mertz-Fairhurst and et al.[38] report 9-year results of restorations placed over carious lesions after minimal preparation. In addition to proving that the lesions did not progress below intact restorations in those 9 years, the authors conclude that sealed restorations are superior to traditional amalgam restorations. The three types of restoration were unsealed amalgams, amalgams with sealant, and composites with sealant. When sealant remained intact, so did the restorations. Failures at margins occurred in 17% of the amalgam restoration, but only in 1% of the composite/sealant and 2% of the amalgam/sealant restorations.

Therefore, the bonded one-surface restoration with sealant overlay has proven a very effective long-term method to treat Class I carious lesions. These restorations have equivalent or better success than amalgam restorations. The longevity of the PRR is dependent to a great extent upon the retention and repair of the overlying sealant. Once again, maintaining the sealant in good condition is shown to be important. This argues for careful sealant upkeep by the dental team.

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Summary

In summary, review of sealant and preventive resin data show:

1. Sealant loss (at least partial loss) is common and a regular event averaging between 5 and 10% each year.
2. Anything more than minimal, partial loss yields a surface with the same caries rate as a nonsealed surface.[11, 12]
3. Regular maintenance and sealant addition when necessary is important in long-term caries protection after sealant placement.
4. Much better effectiveness data will result if sealants are used on teeth with a true predilection to caries
5. Better materials and better use of bonding agents with sealants will improve overall effectiveness on all teeth—particularly on those teeth now thought of as difficult to seal.

Conclusions

1. Sealant bonding that is less moisture-sensitive will open up the beneficial use of sealants to patients who are not able to comply with rigorous isolation methods, i.e., handicapped or very young patients.

2. More realistic expectations for sealants will drive marketing and payment plans for sealants such that the practitioner is not liable for the normal wear-and-tear losses of the material.

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