Pit & Fissure Sealants: The Added Link in Preventative Dentistry

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Continuing Education Units: 2 hours


Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

This course presents an overview of dental pit and fissure sealants as a safe and effective way to prevent dental caries. The course starts with a brief look at the history of dental sealants followed by the current rationale for their use. Frequently asked questions about sealants are addressed along with the presentation of guidelines for sealant use. Information about materials currently used for sealants is presented along with general instructions for the successful placement of sealants. The use of sealants in public health programs is also addressed.

Conflict of Interest Disclosure Statement
• Mary Ann Haisch has done consulting work for P&G.

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Overview
This course presents an overview of dental pit and fissure sealants as a safe and effective way to prevent dental caries. The course starts with a brief look at the history of dental sealants followed by the current rationale for their use. Frequently asked questions about sealants are addressed along with the presentation of guidelines for sealant use. Information about materials currently used for sealants is presented along with general instructions for the successful placement of sealants. The use of sealants in public health programs is also addressed.

Learning Objectives
Upon completion of this course, the dental professional should be able to:
• Describe current findings and recommendations on the effectiveness and safety of pit and fissure sealants.
• Discuss why the use of pit and fissure sealants has been controversial.
• List and identify the different natural occlusal characteristics of human teeth that could benefit from sealant placement.
• Describe the sealant placement decision tree and how it helps determine the need for sealant application.
• Discuss the different methods of preparing the teeth for sealant placement.
• Describe the proper tooth preparation, isolation, etching, rinsing and drying, sealant application, evaluation, and follow-up in placing dental sealants.
• Discuss the third generation of sealant materials, glass-ionomer, the change in placement procedures, the cost differentials, fluoride release, effectiveness and supporting literature.
• Discuss the use of pit and fissure sealants in public health programs.
• Use high quality Evidence for health care decision making.

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Introduction
Protecting the natural pits and fissures of newly erupted teeth from dental decay is not a new concept. There have been numerous references to eradicating pits and fissures since 1923 when H. T. Hyatt proposed removing these defects and replacing them with amalgam in a procedure called prophylactic odontonomy. Subsequent approaches have used various materials and chemicals. Cueto and Buonocore made the most significant contribution in 1955 when they introduce the concept of enamel bonding.

Enamel bonding offered promise for the one area of the human tooth that was particularly susceptible to dental caries. By 1955 there was a sufficient amount of research to support the use of fluoride in public water systems and topical application by dental professionals. Along with the use of fluoride, it was widely recognized that the reduction of fermentable carbohydrates in the diet, routine dental examinations, routine dental care, and the daily removal of plaque from the teeth reduced the incidence of tooth decay. At the same time it was apparent that the pits and fissures that form the occlusal surfaces of the human teeth remained vulnerable. Using enamel bonding to seal the pits and fissures offered an added link in preventive dentistry.
In 1983 the National Institutes of Health published a report entitled, “Consensus Development Conference Statement on Dental Sealants in the Prevention of Tooth Decay.” This report recommended the use of pit and fissure sealants as a safe and effective method of preventing pit and fissure decay. In addition, it addressed significant roadblocks to sealant use such as availability, insurance coverage, and questions of enamel maturation.

Following the publication of this report, many states changed their dental practice acts to allow dental auxiliaries to place pit and fissure sealants. Currently all state practice acts allow dental hygienists to place pit and fissure sealants and the majority of states allow dental assistants to perform this procedure. This information also resulted in many dental insurance companies looking at sealant placement not as an experimental procedure but as a cost-effective prevention measure.

Continued review of the dental literature indicates ongoing documentation of successful sealant retention rates, reduction of occlusal caries, and the economic impact of a caries-free population. Both public health programs and private practice surveys give positive results for the placement of pit and fissure sealants.

An added benefit of placing pit and fissure sealants is the positive dental experience it provides for children. Almost without exception, the placement of pit and fissure sealants is painless and non-traumatic.

Rational and Patient Selection
According to the “Workshop on Guidelines for Sealant Use: Recommendations” published in a special issue of the Journal of Public Health Dentistry in 1995, the following principles and scientific facts should underlie the use of pit and fissure sealants in private and public programs:

- Prevention of dental caries is better than treatment; therefore, sound, diseased teeth are more highly valued than adequately restored teeth.
- For equivalent outcomes, the least invasive approach, using the simplest intervention for managing dental caries, is preferred.
- Minimizing the cost of preventing or controlling pit and fissure caries is desirable.
- Strategies for sealant use (e.g., patient selection, clinical decision making) may differ between individual care and community programs.
- Sealants have been demonstrated to be a safe and effective long-term method to prevent pit and fissure caries.
- Pit and fissure caries attacks begin in childhood and continue throughout adolescence and into adulthood.
- In addition to preventing carious lesions, sealants can arrest caries progression.
- Effective sealant use requires meticulous application techniques, particularly moisture control. Sealant retention should be checked within one year of application.

Continuing evidence presented in the “Executive summary of evidence-based clinical recommendations for the use of pit-and-fissure sealants” recommends that sealants are not standard of care but a useful tool that can be used in making evidence-based decision about sealant use.

Guidelines for patient use in private practice differs somewhat from guidelines used in community sealant programs. Those seeking treatment in private practice settings are more likely to have continuous care, comprehensive diagnoses, and treatment options. People treated in community sealant programs are more likely to be episodic users of primary dental care services.

Risk assessment techniques for dental caries are useful in determining which patients would most likely benefit from the protection provided by the sealant. Tooth morphology, caries history, family history, home care, history of dental care, and eruption schedule (age) all play a role in selecting this procedure for a patient.

In spite of high prevalence of fissure sealants there is an unequal caries experience among 12 year old children from different educational strata. To improve this situation, persons important to the promotion of dental health should try to ensure fissure sealant application to permanent teeth as early as possible, especially in those children who have had caries in their primary dentition.
As noted above, tooth morphology plays a role in selecting specific teeth for pit and fissure sealants. The above photograph of a normal first mandibular molar shows the natural occlusal morphology that tends to make cleaning difficult and creates areas for food impaction (Figure 1). It also illustrates a less than ideal situation for diagnosis of incipient lesions. The following photographs which show the anatomy of the tooth surface in detail, further illustrate the need to seal these types of fissures (Figures 2-4).

It has been well documented that the tooth surface is constantly undergoing a remineralization and demineralization process. This makes the decision to cut into the tooth versus a non-invasive procedure a difficult one at best.

It has been documented occlusal caries account for 43% of all caries surfaces in 6 and 7 year olds, 57% in 12 to 14 year olds, and 69% in those over 16. Therefore, almost 70% of carious lesions are on approximately 12% of the surface of the tooth. One study with longer follow up showed that after 9 years only 27% of sealed tooth surfaces were decayed compared to 77% of tooth surfaces without sealant.

**Materials**

The current sealant material of choice is a resin – dimethacrylate monomer (BIS-GMA) diluted with a co-monomer. The American Dental Association’s Council on Scientific Affairs has approved a number of commercially available sealants. Researchers have published several clinical studies involving many of the listed materials, however, no one material stands out as superior to the rest. Initial studies using glass ionomer fissure sealants in primary teeth indicated no evidence of effect on caries incidence; further studies need to be done to see if this is a viable material for fissure sealant.

Curing of sealant materials occurs one of two ways. Some sealants are chemically cured through a process called autopolymerization. These materials are dispensed as two components. As soon as the components are mixed the polymerization begins. The curing is complete in approximately 60 seconds. Other sealant material is cured with visible light. When using the light cured materials, it is very important the curing light is of high quality and is tested frequently for the value of the light emitted. The retention rates for chemically cured and light cured sealants have been compared in numerous studies and offer similar results.

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**Figure 1.** Normal first mandibular molar.

**Figure 2.**

**Figure 3.**

**Figure 4.**
Dental material manufacturers offer a variety of sealant materials designed to meet the preferences of individual operators. These products include sealant materials that are unfilled, filled with an opaquer, clear, and colored and those products that change color when cured. Convenient unit-dosed material is also available. There appears to be no difference in the retention rate. The filled materials are often easier to see and monitor, but the clear materials allow the operator to continue to see the filled fissures. Sometimes operators prefer the colored sealants to make monitoring retention easier. Patients and parents should be consulted prior to the placement of colored sealants.

Most resin based material are fluoride releasing. The fluoride is released from the sealant after polymerization. The clinical significance of this has not yet been determined. The fluoride release is thought to be at the base of the sealed groove, which provides a fluoride rich layer available when remineralization of an incipient lesion takes place. Additional research is needed in this area.

Recent studies on new materials include compomer-based materials, marketed by Dyract Flow and Dyract Seal. Initial clinical results indicate they were equal to conventional resin-based composite fissure sealants regarding sealing and superior with respect to absence of pores. Triage – GC America is a glass-ionomer product with fluoride release has proven to be equally as effective as resin based products. The fluoride release is much greater and the placed sealants have the ability to recharge when exposed to fluoride in the oral environment. The cost of the material is less and it is less technique sensitive due to the ability of the material to be placed on a wet surface also decreases operator time.

A recent review of sealant products indicated most of those products, both new and existing, are composite resins. Primers and bonding agents have been introduced, but clinical evidence in the use of bonding agents is inclusive and not recommended at this time.9,10

**Issues**

Almost every study confirms the reduction of pit and fissure carious lesions with the placement of sealants, but the acceptance by the dental community and patients has never been strong. Some of the same concerns that were brought up when sealants were first introduced continue to be issues even as scientific evidence supporting the use of sealants continues to grow. It is possible that these concerns are responsible for the under-utilization of this proven preventive procedure. The following list includes some common questions that continue to be asked regarding the use of pit and fissure sealants:

**Sealing Incipient Lesions – Do the Caries Continue to Progress?**

Research findings consistently indicate the caries process is inhibited when sealants are applied to incipient lesions. These findings have been demonstrated radiographically and microscopically. One longitudinal study on 96 children in a public health program showed initial incipient surfaces that were sealed had a 10.8% caries rate, while unsealed surfaces reached 51.8%. Additional work has been done by Dr. Eva Nertz-Fairhurst, where she covered frank occlusal caries visible on radiograph with a composite resin and sealed the contiguous fissures. The cavity preparation was extended laterally to sound enamel margins while caries removal was not performed. At the ten-year follow up, these “sealed resins” performed as well as conventional amalgam restorations where all caries were removed.

**Retention Rates – What if the Sealant Falls Out?**

In general, properly placed sealants do not fall out. Cochrane Database of Systematic Review concluded, the reduction in caries ranged from 86% in 12 months to 57% at 48 to 54 months. If the occlusal bulk wears away or is lost, there is clinical evidence that the resin tags remain and the surface is protected. The photograph in (Figure 5) shows a sealant with the tooth structure dissolved leaving only the resin tags.

![Figure 5. Sealant with the tooth structure dissolved.](image-url)
Technique
Dentists, dental hygienist, and in many states dental assistants can place sealants. State practice acts make the determination as to who can diagnose, supervise, and place sealants. Many states require some type of educational program sometimes with a laboratory as well as a clinical program to qualify auxiliaries to place sealants.

Placing sealants is not without problems. New materials and improved dental equipment has certainly made the application procedure easier and more successful. Potential problems start with the age of the patient. Many 6 to 7 year olds have never had a dental procedure outside of examinations and cleanings. This procedure should be as pleasant as possible; this might be the introduction of dentistry to a child and if the least bit traumatic could set a pattern for life.

Procedures for Pit and Sealant Placement

Tray Set Up
Prior to the start of the procedure, a tray with all necessary instruments, supplies, and equipment should be prepared. The items listed below are included in the sample tray set-up (Figure 6).

Each operator needs to determine what should be included on the tray based on personal preferences and the sealant material being used.

Step One – Clean the Tooth Surface
The tooth surface must be thoroughly cleaned prior to the placement of the sealant. Cleaning

Etching Removes Enamel – Will the Unsealed Etched Surface Be More Susceptible to Caries?
Remineralization begins as soon as saliva coats the surface and forms an organic pellicle over the etched tooth structure; thus, the tooth surface is protected. For reference, the etching process used for sealants removes about 10 microns of enamel and polishing with pumice removes about 4 microns.

Cost Effectiveness – Do You Save Money?
Dental insurance claims for over 1.3 million children were examined for a three-year period and it was found the average cost of a one-surface restoration was more than double the cost of a sealant. In a confirming survey conducted by the American Dental Association in 1982 a similar ratio was found. Having auxiliaries do the procedure can also reduce the cost. Placing sealants at the time of the recall appointment and using a risk assessment protocol to determine which surfaces to seal are also ways to reduce cost.

Removing Tooth Structure – Is it Necessary?
Using a bur to clean out pits and fissures and the placement of a composite resin restoration is a common procedure in placing a sealant. The procedure, preventive resin restoration, is billed as a one surface restoration. Local anesthetic is used in many cases and auxiliaries cannot do the procedure. Air abrasion is sometimes used to clean out pit and fissures prior to placement of sealants. Many states interpret the use of air abrasion as removal of hard tooth structure and, therefore, not all auxiliaries will be allowed to place the sealant materials. Labor is a major cost in the dental office; it is more effective to use qualified auxiliaries.

Payment – Do Insurance Companies Cover this Procedure?
Medicaid coverage in all 50 states covers the placement of pit and fissure sealants. Most Health Maintenance Organization’s dental plans cover sealants as a preventative procedure. Also, many of the fee for service plans cover sealants because they have determined that the use of sealants is a cost effective method of preventing higher cost restorative treatment.

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Figure 6. Tray set-up.
Mirror Slow Speed Handpiece
Explorer (No. 5) Toothbrush
Cotton Pliers Material
Isolation Device Directions
Saliva ejector Curing Light
Syringe Tip Articulating Tape
can be accomplished using hydrogen peroxide, a toothbrush, a prophy cup or brush, or a prophy jet. Products containing fluoride and/or glycerin are contraindicated and should not be used to clean the tooth. Pumice should not be used to clean pits and fissures as the particles of pumice can prevent the acid etch and the resin from flowing into the fissure. After cleaning, the surface should be rinsed approximately 20 seconds. An explorer should then be used to examine the entire tooth surface for any remaining debris and previously undetected pathology. If debris remains, the tooth surface should be cleaned again. If pathology is detected, the decision to seal the tooth should be reevaluated (Figures 7 and 8).

**Step Two – Isolate the Tooth Surface**

Isolation is the most critical issue in the proper placement of sealants. If the surface of the etched tooth is contaminated by saliva, the resin material will not adhere because the remineralization process begins as soon as saliva touches the etched surface. Sealant loss and immediate failure of retention are most often linked to moisture or salivary contamination. Rubber dam is the ideal method for tooth isolation for sealants, but it is not always possible or appropriate for young children. Cotton rolls, dry field pads, dry field kits, and single tooth isolation are all used with success. New materials are being studied that do not require isolation to limited success, further investigations are underway. (Figure 9 illustrates acceptable isolation methods).

If using a glass-ionomer product isolation is not necessary as these products are not sensitive to moisture contamination.

**Step Three – Etch the Tooth Surface**

Etching the surface of the tooth, also called conditioning, is accomplished by using 38% orthophosphoric acid. The acid use in etching the tooth has the additional benefit of killing the bacteria in the pit and fissures. This acid is available in liquid and gel. If you choose to use a gel, it is important to use a gel product that is specifically designed for pit and fissure sealants. Other gels may be too viscous and will not flow properly into the pits and fissures. The etching time is approximately 20 seconds for both primary and permanent teeth (Figures 10 and 11 illustrate the placement of acid on the tooth surface).

Etching is not necessary with the glass-ionomer products, a surface conditioner may be used if desired.

![Figure 7](image1)

![Figure 8](image2)

![Figure 9](image3)

![Figure 10](image4)
Step Four – Rinse and Dry the Tooth Surface
After etching for 20 seconds, the surface needs to be rinsed with water to remove the acid. Suction and air should be used to thoroughly dry the etched tooth surface. Again, it is extremely important to avoid salivary contamination. If the tooth surface is contaminated by saliva, it will be necessary to repeat the etching process (Figures 12 and 13).

A properly etched surface will appear chalky (Figure 14). A microscopic view of an etched tooth surface (Figure 15).

Step Five – Apply the Sealant Material
It is important to be familiar with the particular sealant material being used. Some operators find it helpful to place a photocopy of the manufacturer’s instructions on the tray set-up and review them before beginning the procedure.

Chemically cured sealant material includes two components that must be mixed just before placement. The curing process starts as soon as the materials are mixed and there is a limited amount of time when the material can be successfully placed in the pits and fissures.

Light cured sealant material is placed as dispensed without any mixing. The curing process does not begin until it is exposed to the light source.

Sealant material is placed on the prepared tooth using a syringe (Figure 16). Regardless of how it
is delivered, it is important to limit the amount of material. The sealant material should be placed only in the pits and fissures. Too much material can result in occlusal interference. Although occlusal interference is not a concern, the amount of material should also be limited when sealing pits and fissures on lingual and buccal surfaces.

**Step Six – Curing the Sealant**
After the light cured sealant material is applied and the operator is satisfied that all surfaces are coated using the correct amount, the sealant should remain undisturbed for 20 seconds before applying the curing light. This twenty-second delay allows the resin to flow into the etched surface. It takes about 30 seconds of concentrated visible light to set the light cure material. The tip of the curing light wand should be held approximately 3 to 5 mm from the surface of the sealant (Figure 17).

As previously stated the curing process for chemically cured sealant material begins as soon as the material is mixed. After the material is applied and the operator is satisfied that all surfaces are coated using the correct amount, the sealant should remain undisturbed for 60 seconds. The sealant material will be completely cured 60 seconds after mixing.

**Step Seven – Evaluate the Sealant**
Immediately after the material has cured the sealant should be evaluated for retention, flaws, and occlusion. Use an explorer to check for retention and flaws. If a sealant is going to fail, it most likely will do so immediately. If there are bubbles, voids, or any portion of the material comes out, more sealant material may be added. It will be necessary to re-isolate and etch before placing the material again.

The occlusion of the sealant should be checked with articulation tape (Figures 18 and 19). If there is any indication of interference, the excess sealant material should be removed using a round finishing bur in a high or slow speed handpiece.

**Documentation**
An appropriate entry should be made in the patient's record indicating the date, surfaces sealed, type of material used. Depending on the circumstances the operator may want or need to provide other pertinent information.

**Follow-up**
Pit and fissure sealants should be checked annually (Figure 20). If some or all of the material has been lost, it should be replaced. Regular
radiographs are helpful to follow the success of this procedure.

**Conclusion**

Dental sealants are truly the added link in preventive dentistry. The application of sealants has a profound effect on dental caries on all tooth surfaces. Bravo and his colleagues conducted a clinical trial where they demonstrated that sealing the occlusal surfaces of children’s molars lowered the pit and fissure caries incidence by 68% when compared to an untreated cohort. Additionally, there was a concomitant 87% reduction in smooth surface caries in the same treatment group. It appears that removal of this protected environment for cariogenic bacteria has far reaching effects. When a child receives sealants, they are 5.22 times less likely to experience caries on all surfaces than children that do not receive sealants. Ongoing research continues to find this procedure effective, safe, and of a low enough cost that all populations can access this service. With the use of fluorides, regular dental evaluations, patient education, plaque control, reduction of sugar exposure, and the use of dental sealants, successive generations will have healthy, non-restored dentitions.

**Public Health Programs**

Pit and fissure sealants can be placed in many settings; therefore, it is a portable procedure. This has led to many uses by public health dentistry. Most of the historical studies that were used to determine the efficacy of dental sealants were done in public health settings. Since this procedure can be done with minimal equipment and costs, those with access problems can be accommodated. The worldwide dental public health literature still contains many ongoing studies to support the use of sealants as a public health measure. There are programs such as “Seal America” which provide resources for community groups to start sealant programs.

Community dental health projects have taken portable units to schools, community centers, reservations, and residential homes for the developmentally disabled. Many dental and dental hygiene programs do sealant projects for dentally underserved, either at the schools or on location.
Course Test Preview
To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/dental-education/continuing-education/ce128/ce128-test.aspx.

1. According to the Cochrane Database of Systematic Review, what is the one-year reduction in caries following properly placed dental sealants?
   a. 50%
   b. 86%
   c. 75%
   d. 39%

2. How does the cost of placing a dental sealant compare to the cost of placing an occlusal amalgam restoration?
   a. A sealant costs twice as much as a restoration.
   b. A sealant costs about the same as a restoration.
   c. A restoration costs about 50% less than a sealant.
   d. A restoration costs twice as much as a sealant.

3. The need for placement of dental sealants has become more of a necessity because:
   a. Occlusal surfaces are protected by fluorides.
   b. The American diet contains less fermentable carbohydrates than in the past.
   c. Disease trends indicate the majority of caries are occlusal.
   d. The placement of two surface amalgams that cover the occlusal surfaces.

4. Which of following methods of protecting the occlusal surfaces of teeth removes the least amount of enamel?
   a. Preventive resin restorations
   b. Prophylactic odontonomy
   c. Dental sealants
   d. Small amalgam restorations

5. Which of the following is the most critical step in the placement of resin based pit and fissure sealants?
   a. Material selection
   b. Light curing
   c. Isolation
   d. Cleaning the tooth surface

6. What is the appropriate curing time for light cured sealant materials?
   a. 10 seconds
   b. 30 seconds
   c. 80 seconds
   d. 120 seconds

7. When saliva touches the tooth surface, what takes place immediately?
   a. Demineralization
   b. Remineralization
   c. Activation
   d. Nothing
8. **When placing the sealant material it is important to:**
   a. Use the maximum amount of material to insure full occlusal coverage.
   b. Use all of the material in the dispenser.
   c. Use the minimum amount of the material to cover all the pits and fissures.
   d. Use air to move the material around.

9. **After placing the sealant, it is necessary to evaluate the procedure by doing which of the following?**
   a. Exploring for voids or bubbles.
   b. Checking how securely the sealant is attached to the tooth surface.
   c. Checking the occlusion for premature contacts.
   d. All of the above.

10. **Which of the following is the most appropriate method for removing excess material from a polymerized sealant?**
    a. Scraping with a sharp instrument.
    b. Using a finishing bur with a hand piece.
    c. Using prophylactic paste and a brush.
    d. All of the above.

11. **How do acid etching and prophylactic polishing compare with regard to loss of tooth structure?**
    a. Etching removes approximately 10 microns and polishing removes approximately 4 microns.
    b. Etching removes approximately 4 microns and polishing removes approximately 10 microns.
    c. Both procedures remove the same amount of enamel.
    d. Neither procedure removes tooth structure.

12. **Which tooth surface benefits the least from the caries reducing effects of fluoride?**
    a. Root surfaces
    b. Smooth surfaces
    c. Pits and fissures
    d. Proximal surfaces

13. **How do patients seeking dental treatment in private offices differ from those treated in community sealant programs?**
    a. They are episodic users of primary dental care services.
    b. They seek treatment when in pain.
    c. They are more likely to have continuous care.
    d. They do not differ in how they use the dental care system.

14. **There are differences in the retention rates of dental sealant materials.**
    a. True
    b. False

15. **Tooth enamel that is etched but not covered with sealant material will:**
    a. Decay
    b. Demineralize
    c. Discolor
    d. Remineralize
16. Most of the historical studies that proved the efficacy of dental sealants were done in which of the following environments?
   a. University settings
   b. Private dental offices
   c. Public health settings
   d. Dental hygiene clinics

17. Bonding agents should always be used in placing pit and fissure sealants?
   a. True
   b. False
References

Additional Resources
10. Focus on Dental Sealants–Biblio Alert–HRSA
About the Author

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Mary Ann Haisch is an assistant professor in the School of Dentistry at Oregon Health & Science University. She received her dental hygiene education from Clark College, Vancouver, WA, her Bachelor of Science in Health Education, certification in gerontology and her master in Public Administration from Portland State University. Her areas of interest include the use of technology in dental and dental hygiene education, interactive distant learning, the use of the internet for dental continuing education and is actively involved in the development of faculty tools to incorporate interactive technology in dental and dental hygiene curriculums. She is also involved in the recruitment and retention of dental and dental hygiene students. She is an educational consultant and speaker for Procter & Gamble, has held offices in the American Dental Education Association and is on the editorial board for the Journal of Practical Hygiene.

Presently Ms. Haisch is faculty emeritus in the School of Dentistry and coordinates community outreach activities and continues to see patients.

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