



Advancing the Art and Science of Dental Hygiene Through Oral Malodor Management

Abstract

As evidenced by the billion-dollar oral health and breath product market, the interest on the part of consumers for accurate information in the treatment of bad breath continues to grow. A recent survey determined that consumers expect the dental professional to assess for oral malodor-

ous conditions and yet this topic is often avoided. This article will present the science and conditions related to oral malodor, methods to assess and treat, techniques to provide clinical intervention, and methods to maintain fresh breath on a daily basis.

Dental professionals and especially registered dental hygienists are in a position to assist patients in assessing oral malodor conditions and addressing the causes while recommending daily intervention for fresh breath. While this condition has been viewed as mainly a social embarrassment, there are real disease-related components that warrant further concern by the dental community. In addition, the American Dental Hygienists' Association defines optimal oral health "as a standard of health of the oral and related tissues, which enables an individual to eat, speak, or socialize without active disease, discomfort, or embarrassment and which contributes to overall well-being and total health."¹

This definition reaches beyond disease-based parameters of health and includes focus on what malodor means most to patients—social factors. Dental professionals who have embraced oral malodor treatment and discussion into their treatment regimens have gained patient appreciation and a new way to motivate patients to optimal oral health.

Malodor Origins

The term *halitosis* has been used to describe bad breath when in fact it actually refers to odor generated from the gastric track or gut. Malodor can be segmented into 7 main categories:^{2,3}

1. mouth and tongue
2. nasal, nasopharyngeal, sinus, and oropharyngeal
3. xerostomia induced
4. primary lower respiratory tract and lung
5. systemic disease
6. gastrointestinal diseases and disorders
7. odiferous ingested foods, fluids, and medications

Systemic-based malodor makes up a very small percentage of odor-related conditions, with an estimated 80% or more of malodor being oral related.⁴ This can further be delineated into chronic and transient conditions. Transitory malodor is generally a result of ingesting foods, liquids, or medications with an odor component that will last only

24 to 72 hours. This is also referred to as an extrinsic pathway or etiology. External substances are ingested resulting in absorption into the circulatory system and release of odors via breathing and saliva. The best way to control this type of malodor is to avoid or refrain from ingesting the

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offending substances.³

Chronic malodor, on the other hand, is a daily occurrence caused by oral conditions with only 10% related to systemic causes.^{3,4} This type of malodor is a result of intrinsic causes, such as presence of oral infection and/or bacteria by-products such as volatile sulfur compounds. The mouth and tongue sources account for the greatest area of interest for dental professionals. Intra-oral niches responsible for oral malodor production include the posterior dorsum of the tongue, periodontal pockets/gingival sulcus, and tonsillar region. In addition, xerostomia has been identified as a major



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contributor to oral malodor.

The geography of the tongue provides the ideal surface for bacteria and food retention, and without daily cleansing can be a major source of oral malodor. A typical tongue coating contains dead epithelial cells, food debris, blood cells, and bacteria.² Additionally, periodontal pocketing of 4 mm or more is noted for the accumulation of bacteria related to both periodontal diseases and oral malodor.² Correlating pocket probing depths with oral malodor production will provide additional profound and new motivation for patient involvement. Finally, the tonsillar tissue also can harbor bacteria, especially in tonsilloliths, small semicalcified bacteria, putrefied food, and other material embedded in the tonsillar crypts. Focusing on these areas of the oral cavity will assist in effective oral malodor management both clinically and on a daily basis.

Oral Malodor Physiology

The primary cause of oral malodor is a combination of gram-negative anaerobic bacteria, oral pH, and/or the presence of oral infections. Gram-negative, anaerobic bacteria produce odor-related compounds called volatile sulfur compounds, which are by-products of bacteria metabolism much like the more commonly known endotoxins that destroy periodontal tissue. In essence, these bacteria produce both gaseous (volatile sulfur compounds) and "solid" (endotoxins) by-products. The primary volatile sulfur compounds produced by flora include hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyldisulfide. While hydrogen sulfide is associated with patients who are periodontally healthy, methyl mercaptan is associated with those who have periodontal disease.^{2,4,5}

Volatile sulfur compounds also have been associated with an increase in mucosa permeability,

Learning Objectives

After reading this article, the reader should be able to:

- identify the 7 main categories of malodor and differentiate between oral and systemically based malodor.
- list the compounds associated with oral malodor and their relationship to periodontal disease.
- discuss clinical intervention, including mechanical debridement and chemotherapeutic usage.
- identify those chemotherapeutic agents effective in oral malodor treatment and their mechanism of action.

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which permits more bacteria and endotoxin invasion and may lead to the progression of periodontal infections. These compounds have been shown to interfere with collagen and protein synthesis as well as to suppress DNA synthesis, thereby impeding wound healing.^{6,9} Research also has suggested that the presence of these compounds may accelerate the infection process.¹⁰ As a result, neutralizing volatile sulfur compounds to eliminate odor may have even more importance in periodontal health.¹¹ Therefore, oral malodor management should take into account methods to eliminate or neutralize volatile sulfur compounds.

The bacterial activity combined with existing oral conditions all lead to the presence of oral malodor. The following conditions are prime examples: periodontitis, aphthous ulcers, abscesses, candidiasis, xerostomia, gingivitis, traumatic ulcers, herpetic infection, oral cancer, and poor oral hygiene. As the shift from individual bacteria to that of biofilms begins to evolve, consideration of the conditions and niches in which biofilms thrive will arm clinicians with more information to effectively combat oral malodor as well as other oral-related diseases and conditions. With respect to oral malodor, it is important to correlate the presence of biofilms/bacteria on the posterior dorsum of the tongue, in the gingival sulcus/periodontal pockets, and in the tonsillar tissue.^{2,3}

Assessment and Intervention

The science of oral malodor has been elusive because of many factors, including diagnosis, variations throughout the day, gender, and subjectivity. As a result, the exact science relating to oral malodor assessment and diagnosis has not been qualified, so dental professionals should consider the easiest route when dealing with oral malodor discussion. Understanding that oral malodor can present itself at any time, the most reliable means for patient diagnosis is

through a trusted counterpart, such as a family member or spouse. Aside from this, clinicians can be confident that every patient will have interest in methods to maintain fresh breath, and an approach that includes this fact will assist clinicians in providing oral malodor management strategies to all.

The primary factors associated

with oral malodor production include salivary flow, presence of biofilms/grain-negative anaerobic bacteria, the oral pH, and the presence of cellular protein and/or food debris. These factors are indicative of the manifestation of oral infections, particularly periodontal diseases. Patient assessment should include consideration of these factors

Table 1—Proposed Clinical Protocol for Oral Malodor Management

The dental hygienist is in a key position to implement a patient-centered approach that addresses social considerations and ultimately improves oral health. The following protocol represents a suggested process of care that includes oral malodor assessment and traditional dental hygiene treatment.

Assessment Phase

1. Review medical history
 - Include questions regarding family history of systemic illnesses, dry mouth, etc
2. Review current oral hygiene routine
 - Assess "real" time and tools used, as well as technique
3. Determine current use and frequency of use of oral malodor products
 - Toothpaste: specific brand/times per day
 - Mouth rinse: specific brand/times per day and amount of time rinsing
 - Breath mints: specific brand/times per day
 - Chewing gum: specific brand/times per day
 - Other: tongue gels, breath sprays, etc
4. Perform oral cancer screening
5. Perform comprehensive periodontal examination
 - Pocket depths of 4 mm or greater are more likely to produce volatile sulfur compounds
6. Note the condition of the surface of the tongue
 - Tongue coating in periodontal patients is 4 to 6 times greater than in nonperiodontal patients
7. Identify restorations, crowns, and bridges that need replacing
8. Note the presence of oral lesions and tonsilloliths

Clinical Protocol

1. Use pre- and postprocedural antibacterial mouth rinse to neutralize volatile sulfur compounds
2. Eliminate/reduce plaque and calculus. For patients with periodontitis, initiate full-mouth disinfection as follows:
 - Instrumentation as indicated
 - Subgingival irrigation to neutralize volatile sulfur compounds via automated scalers or other irrigation device
 - Remove remaining plaque from interproximal regions
 - Perform selective polishing as indicated
 - Perform tongue deplaque procedure using tongue scraper and antibacterial/volatile sulfur compound neutralizing agent
3. Evaluate for additional preventive care
 - Sealants
 - Topical fluoride treatment
 - Daily fluoride use
4. Instruct patient on daily care for fresh breath maintenance and make product recommendations
5. Reappoint as indicated and evaluate oral malodor management success

because oral malodor management will include addressing each of them.

The goals of oral malodor management (Table 1) include increasing

salivary flow, eliminating gram-negative bacteria/biofilms from key intra-

oral niches (posterior dorsum of the tongue, sulcus/periodontal pockets, tonsillar region), and neutralizing volatile sulfur compounds.¹²

Increasing Salivary Flow

Decreased salivary flow has many causes and results in xerostomia. Medications, medical conditions, and various oral habits can lead to dry mouth or reduced salivary flow.¹³ Not only will oral malodor be more prevalent in this population but also other oral health concerns arise, including the potential for increased decay. As a result, methods to increase salivary flow warrant careful consideration and include the use of saliva substitutes (oralbalance Mouth Moisturizing Gel, Laclede, Inc, Rancho Dominguez, Calif, www.laclede.com; Salivart[®], Gebauer Company, Cleveland, Ohio, www.gebauer-co.com), increasing water intake, and chewing sugar-free gum or mints. If possible, recommend chewing gum or mints that contain xylitol (Biotène[®] Dry Mouth Gum, Laclede, Inc; TheraGum[™], Omnil Pharmaceuticals[™], West Palm Beach, Fla, www.omnipharma.com), which is known to prevent caries. In addition, products that contain zinc will be beneficial in neutralizing volatile sulfur compounds (Halispheres[™] BreathRx[™] Sugar-Free Chewing Gum, Discus Dental, Inc Culver City, Calif, www.discusdental.com).

Alcohol-based mouth rinses should be avoided because they may desiccate the oral mucosa and worsen xerostomia symptoms.^{13,14} Alcohol-free mouth rinses, such as Biotène[®] Gentle Mouthwash (Laclede, Inc), BreathRx Anti-bacterial Mouth Rinse (Discus Dental, Inc), and Rembrandt[®] Dazzling Fresh[®] Mouthwash, Rembrandt[®] Plus[™] Peroxide Whitening Rinse, and Rembrandt[®] Age-Defying Mouthwash (Den-Mat Corporation, Santa Maria, Calif, www.rembrandt.com) contain active ingredients to neutralize volatile sulfur compounds and combat bacteria growth. Biotène[®] Mouthwash also helps replace key salivary enzymes for patients with xerostomia.

Eliminating Gram-Negative Bacteria and Biofilms and Neutralizing Volatile Sulfur Compounds

Methods to reduce bacteria and biofilms in patients with oral malodor are not unlike standard dental

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Table 2—Oral Hygiene Recommendations for Fresh Breath

- Automated toothbrushes
- Automated interdental devices
- Active agent impregnated floss
- Tongue scrapers/deplaquing devices combined with antibacterial tongue gels or sprays
- Toothpastes, mouth rinses, mints, chewing gum, and other vehicle options that contain a neutralizing agent
- Chewing gum, mints, or lozenges that contain xylitol or other active ingredients such as zinc; avoid products with sugar

Table 3—Active Agents for Neutralizing Volatile Sulfur Compounds and Impacting Gram-negative Oral Flora

- Zinc**—the most recognized and effective agent for neutralizing volatile sulfur compounds
- Essential oils**—known antigingivitis properties
- Chlorhexidine gluconate**—broad-spectrum antimicrobial agent that also neutralizes volatile sulfur compounds
- Chlorine dioxide**—known agent for neutralizing volatile sulfur compounds as well as mild antimicrobial activity
- Cetylpyridinium chloride**—known mild antimicrobial agent
- Triclosan**—known mild antimicrobial agent
- Combination of above agents

hygiene intervention, including scaling and root planing. Cleaning the tongue is an addition to standard clinical protocols and represents the most dramatic means for controlling oral malodor on a daily basis and providing clinicians with an effective visual/educational tool.

Clinical intervention begins with a careful review of oral tissues and a thorough periodontal examination and provides an excellent opportunity to begin oral malodor discussion. During the periodontal examination, inform patients that probing depths greater than 4 mm will produce bad breath—this will lead to an involved and even interested patient. Oral lesions, tonsilloliths, and restorations that trap food and bacteria also are a common source of oral malodor. The assessment should make note of the tongue coating, including the color, texture, and description of the coating. It can be 4 to 6 times greater in patients with periodontal disease than in those without. The tongue coating is an excellent example of a complex biofilm that has been proven to contribute not only to oral malodor, but to periodontal disease as well.¹⁵

The clinical phase should continue to focus on the removal of plaque and bacteria via instrumentation. Agents that will assist in neutralizing volatile sulfur compounds will assist in jump-starting the oral malodor management regimen. Rinsing with neutralizing agents before and after procedures will decrease oral malodor, and irrigating with these agents

will neutralize subgingival volatile sulfur compounds.¹² Irrigation is most effective through a powered scaling device and subgingival inserts. Tongue cleaning or deplaquing is the best way to control oral malodor on a daily basis and should be implemented at every preventive appointment. Many clinicians choose to deplaque the tongue

at the conclusion of the appointment while having patients observe the procedure. This alone will significantly reduce oral malodor and provide another excellent opportunity to discuss fresh breath maintenance.

For patients with periodontal disease, clinicians should consider implementing full-mouth disinfection or accelerated instrumentation-

phased appointments vs standard quadrant scaling and root planning in 4 appointments over several weeks. This is a process of accelerated treatment, which includes full-mouth instrumentation within 24 hours, use of chlorhexidine, and tongue cleaning. This protocol will fast track esthetic treatment plans, periodontal healing, and/or referral for further periodontal treatment.

Full-mouth disinfection research has shown this protocol to be more effective than traditional quadrant scaling and root planning over time (4 appointments with completion in 6 weeks), with a gain in clinical attachment, greater reduction in probing depths, eradication of *Porphyromonas gingivalis*, greater reduction in spirochetes and motile organisms subgingivally, and greater reduction in oral malodor with the results being maintained 8 months postinstrumentation.^{14,17}

Suggested modifications to the protocol include use of powered instrumentation and simultaneous administration of neutralizing agents, tongue scraping vs brushing, and treatment phases completed at least within 1 week vs 24 hours.¹⁸ Regardless of the health of the patient, oral malodor education and intervention is warranted and should be an integral part of every preventive appointment.

It is not surprising that the full-

mouth disinfection studies using chlorhexidine resulted in a decrease in oral malodor because this agent has been proven to be effective in neutralizing volatile sulfur compounds.⁹ While pure mechanics are important in oral malodor treatment, just as in periodontal instrumentation, consideration to neutralizing volatile sulfur compounds is impor-

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In addition to chlorhexidine, agents that neutralize volatile sulfur compounds include zinc-containing products (BreathRx) and chloride dioxide products (Closysil[®], Rowpar Pharmaceuticals, Inc., Scottsdale, Ariz, www.rowpar.com). Instrumentation alone will not neutralize volatile sulfur compounds, thus incorporation of neutralizing agents in automated scaling devices or irrigated postinstru-

mentation will be advantageous and complete oral malodor treatment.

Recommendations for Everyday Fresh Breath

While clinical intervention is an important step in fresh breath, maintenance must take place every day (Table 2). Effective oral malodor is accomplished through mechanics,

odontal-related bacteria.⁵ Research has demonstrated that cleaning the surface of the tongue with devices specifically designed for deplaqueing will prove more effective and be easier and safer for patients to use while eliminating more bacteria and by-products from the oral cavity.^{19,20} When combined with neutralizing agents, this process alone will result in longer-lasting fresh breath.^{21,22}

Tongue cleaning should take place at least daily and even more frequently for those with a heavier tongue coating. Morning deplaqueing may be easier for patients prone to gagging and some even complete the tongue cleaning in the shower. This simple procedure will dramatically improve bad breath and is the one single new oral hygiene procedure that will generate interest and motivation for patients.

Month Rises

Most patients are interested in mouth rinses, but there is very little published data to demonstrate the effectiveness of one product over the other with the exception of a study published in June 2002 that compared BreathRx[®] Antibacterial Mouthrinse (CPC [Discus Dental, Inc] with Oxyfresh[®] Zinc Mouthrinse (CD/Zn [Oxyfresh Inc, Coeur d'Alene, Idaho, www.oxyfreshwww.com]), Listerine[®] (EO [Pfizer, Inc, Morris Plains, NJ, www.oral-care.com]), and a control.²³ This nearly 100-participant study evaluated the effectiveness of these products on oral malodor. BreathRx[®] was more effective in reducing oral malodor, in addition to having a cumulative effect. In other words, the breath ratings for the BreathRx[®] group never went back to baseline. Researchers concluded the following:

- The 4 mouth rinses tested are all capable of reducing oral malodor within 4 hours after a single product use, with the mouth rinse containing CPC the most effective and the placebo rinse the least effective.
- The daily use of the 2 commercial mouth rinses (EO or CD/Zn as active ingredient) and the placebo rinse for up to 4 weeks did not reduce oral malodor from week 0 baseline scores.
- The CPC product was the only mouth rinse that reduced oral malodor from week 0 baseline scores after 2 and 4 weeks of daily use.

Daily removal of the tongue coating not only reduces oral malodor but may reduce periodontal-related bacteria.⁵

including daily tongue deplaqueing and chemotherapeutics to neutralize the volatile sulfur compounds. This protocol fits in perfectly with that of general oral health maintenance but provides infinitely more motivation over the traditional disease-motivation model. In addition, patients should be advised about methods for maximizing salivary flow.

Tongue Cleaning

The most important addition to the daily hygiene routine is tongue cleaning. Daily removal of the tongue coating not only reduces oral malodor but may reduce peri-

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• The CPC product was more effective than the other 3 mouth rinses in reducing oral malodor.

Until more comparative data is available, clinicians should select products containing active ingredients that neutralize volatile sulfur compounds and impact oral flora (Table 3). It also will be important for clinicians to introduce a variety of "vehicle" options that contain these agents. Today, active ingredients can be found in mouth rinses, toothpastes, tongue gels and spray, and chewing gums and mints. Avoiding sugar-containing products is important for obvious reasons and avoiding habits that dry the oral cavity also will assist in maintaining fresh breath.

Additional recommendations should include the use of automated toothbrushes and even automatic flossers. Automated plaque control devices provide a safe and effective means for plaque removal that does not require much skill on the part of the user. And given that the average amount of time spent by patients on oral hygiene routines is 24 to 60 seconds, any method that can be more effective within this span of time should be considered and recommended.²⁴

Conclusion

Dental professionals are being sought out more than ever for their role in social enhancements. Oral malodor management and education represents an opportunity to effect patients' lives while providing a motivation that they will respond to and appreciate. The dental professional is obligated to provide the utmost in care, including addressing those issues and concerns of greatest interest to their patients. By actively incorporating oral malodor management strategies into clinical practice, clinicians are that much closer to helping patients achieve optimal oral health through social-based needs rather than relying on the disease-based motivation model. These approaches will not only address patients' concerns but also represent a new and unique method for clinicians to affect oral health and potentially total health. **cont**

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