Current Concepts in the Causes and Treatment of Halitosis

ROBERTA RATCLIFF, RDH, MBA

abstract

DENTAL PROFESSIONALS HAVE THE OPPORTUNITY TO DIAGNOSE AND TREAT ORAL MALODOR EFFECTIVELY BY UNDERSTANDING ITS CAUSE AND RELATIONSHIP TO TOTAL ORAL HEALTH. DISPELLING "OLD WIVES' TALES" AND RECOGNIZING THE CAUSES AND ORAL EFFECTS OF HALITOSIS CAN PROVIDE THE HALITOSIS SUFFERER WITH AN INCREASED SENSE OF SELF-WORTH AND SOCIAL ACCEPTABILITY. THIS ARTICLE REVIEWS THE CAUSES, DIAGNOSIS, AND TREATMENT OF ORAL MALODOR.

The ancient Greeks and Romans wrote about bad breath and its remedies. Hippocrates, the father of medicine, described a remedy for oral malodor that centered around the treatment of periodontal disease. He observed the disappearance of offensive odor when the gingivae returned to health. Periodontal breakdown has continued to be associated with strong breath odor into modern times.

Tonzetich and Richter reported in 1964 that volatile sulfur compounds (VSC) were the primary agents responsible for oral malodor.[1] Volatile sulfur compounds are produced by anaerobic bacteria breakdown of the cell wall polypeptide chains of amino acids, primarily cysteine and methionine, into hydrogen sulfide and methyl mercaptan. Further work by Tonzetich showed that the intensity of VSC concentrations increased with periodontal destruction.[2] The relationship of VSC and periodontal disease was established by Yaegaki and Sanada, who showed that the ratio of VSC, methyl mercaptan, and hydrogen sulfide in the breath of patients with periodontal disease was eight times greater than in those who were periodontally healthy.[3] This study also showed that VSC increased proportionately with total pocket depth.

bio

ROBERTA RATCLIFF, RDH, MBA, IS PRESIDENT AND CEO OF ROWPAR® PHARMACEUTICALS, SCOTTSDALE, ARIZONA, AN ORAL CARE PRODUCTS COMPANY. IN ADDITION TO 28 YEARS OF PERIODONTAL PRACTICE, SHE HAS WORKED AS A DENTAL HYGIENE INSTRUCTOR, A LECTURER ON THE ROLE OF THE DENTAL HYGIENIST IN CONSERVATIVE PERIODONTAL CARE, AND A CONSULTANT TO PRIVATE DENTAL OFFICES IN "HANDS-ON" TRAINING FOR PROGRAM IMPLEMENTATION.

One of the most important contributions by Tonzetich and Ng was their work on the effect of hydrogen sulfide and methyl mercaptan in the permeability of the oral mucosa.[4] The junctional epithelium and the oral sulcular epithelium are considered weak barriers against the penetration of orally derived substances. Rizzo[5] and Ng and Tonzetich[6] demonstrated that the VSC, hydrogen sulfide, and methyl mercaptan increased the permeability of the epithelia, allowing bacterial antigens to pass into the underlying connective tissue. Additional work by Tonzetich et al showed an effect on collagen metabolism in human fibroblast cultures.[7] These studies suggest that VSC have a role in the formation of initial lesions in periodontal disease, an association often overlooked by the dental literature. The close relationship between oral malodor and disease must be taken into consideration in the diagnosis and treatment of bad breath.

In addition, the saliva itself plays a central role in VSC production. According to Kleinberg and Westbay, saliva provides a substrate that is rich in proteins and readily oxidized, thus facilitating oxygen depletion and creating an environment conducive to the production of VSC.[8] The mouth contains the components necessary for the continuous production of VSC and bad breath—bacteria, saliva, and proteins. The pH is also important, as acidity inhibits VSC production, while neutrality and alkalinity favor malodor production. It is believed that the healthy mouth has a slightly acidic pH whereas an unhealthy mouth has an alkaline pH. Additionally, faulty restorations, food impaction, and poor oral hygiene contribute to halitosis. It can also result from habits such as tobacco and alcohol use and/or eating spicy foods.

DIAGNOSIS

Oral malodor may be either chronic or transitory. Chronic halitosis patients may be divided into three groups: 1) those who have it and do not know it, 2) those who have it and know it, and 3) those who do not have it and think they do. The first group includes those who have not been informed of their condition or have performed "self-testing" and concluded that they do not have a problem with their breath. "Self-testing" is done by cupping one's hand over the mouth, breathing into the palm, and then smelling the air to determine if there is an odor. This test is ineffective due to the adaptive sensory phenomenon associated with taste and smell. Miller describes this phenomenon as similar to experiencing a bad smell in a room upon entering, yet after staying in the room for awhile, the odor

Figure 1. Automated periodontal probe detects temperature changes associated with inflammation in the gingival sulcus (PerioTemp, Abiodent, Danvers, MA). *(Used with permission of Abiodent.)*

Figure 2. Portable sulfide monitor, calibrated with hydrogen sulfide and measured in parts per billion (Halimeter, Interscan Corporation, Chatsworth, CA). *(Used with permission of Interscan Corporation.)*

seems to disappear.[9] The odor is still there but the person has "adapted" or lost awareness of it.

Those sufferers in the second group have usually been informed by a caring friend, significant other, or dental professional. These people are likely to be interested in treatment and elimination of the problem. In a study of 68 patients with primary complaints of halitosis, the majority suffered merely from imaginary halitosis. Furthermore, after treatment they were more likely to be dissatisfied with the result.[10] The literature describes many cases of individuals who think they have halitosis and do not. Rosenberg refers to imaginary bad breath as "Halitophobia."[11] Halitophobia has been associated with psychological conditions such as delusion, hypochondria, obsessive-compulsive disorder, and olfactory reference syndrome. These individuals are often obsessive about their oral care and overuse masking techniques.

Up to 90% of oral malodor has been attributed to the oral cavity.[9] The primary site of VSC production is the dorsum of the tongue; a secondary site is the gingival sulcus, with VSC increasing according to the extent of inflammation. The white coating on the dorsum of the tongue has been likened to plaque accumulation on the teeth. Aerobic bacteria accumulate on the posterior dorsum of the tongue, and deplete oxygen, which leads to an anaerobic bacterial shift in the deeper layers.[12] Volatile sulfur compounds are then produced by the degradation of salivary proteins. The concentration of VSC in the saliva and the soft tissue reaches saturation and volatilizes, producing a foul odor.

Systemic sources of malodor include medical conditions and drug ingestion. Medical conditions known to contribute to oral malodor include: diabetes, liver dysfunction, pulmonary disease, and renal failure. Medications that can contribute to bad breath are those prescribed for high blood pressure and the common cold, as well as those used to treat systemic diseases (Table).

DISPELLING "OLD WIVES' TALES" AND RECOGNIZING THE CAUSES AND ORAL EFFECTS OF HALITOSIS CAN PROVIDE THE HALITOSIS SUFFERER WITH AN INCREASED SENSE OF SELF-WORTH AND SOCIAL ACCEPTABILITY.

Xerostomia (dry mouth) has also been associated with bad breath. The salivary flow plays an important role in pH balance, bacterial types, and the health of the mouth. Artificial saliva (e.g., Oral Balance, Laclede Professional Products, Gardena, CA; Salivart®, Gebauer Company, Cleveland, OH; Thayers® Dry Mouth Portable Spray, Henry Thayer & Company, Westport, CT) is among the many products available to alleviate xerostomia. Diminished salivary flow and the resultant increase in dry mouth in older individuals has been associated with halitosis. The aging process contributes to reduction in body secretions, including salivary flow. Reduction in salivary flow along with medical conditions and prescription drugs all contribute to a higher prevalence of oral malodor in the older population. In all adults, mouth breathing and snoring can contribute to bad taste or odor upon arising in the morning.

A full medical history must be taken to identify the contributions of medical conditions or medication use to a breath problem. A consultation with the physician, pharmacist, and possibly a nutritionist may be indicated.

A complete dental examination is essential in order to discover all of the possible oral areas that may contribute to a breath disorder. This should include evaluation of the tongue and dental restorations, including partials and dentures, that are niches for plaque accumulation. It is helpful to refer to a full mouth set of x-rays to discover any overhangs, recurrent caries, and bone loss that may be present. Plaque control and oral hygiene habits of the individual should be considered, as the direct correlation between oral cleanliness and oral malodor is of primary importance in developing a treatment plan.

A full periodontal examination is essential to the diagnosis of halitosis. An area associated with the production of VSC is the gingival sulcus. The PerioTemp (Abiodent, Danvers, MA) (Figure 1), an automated periodontal probe with a disposable thermocoupler tip, detects temperature change in the sulcus, in addition to providing probing depths and bleeding sites. After baseline temperature measurements are taken, this instrument can detect minimal changes in temperature that are related to early inflammation[13, 14] and presumably VSC production and changes in the epithelial barrier, which occur prior to the appearance of classic signs of disease, such as increased probing depth and bleeding. The temperature

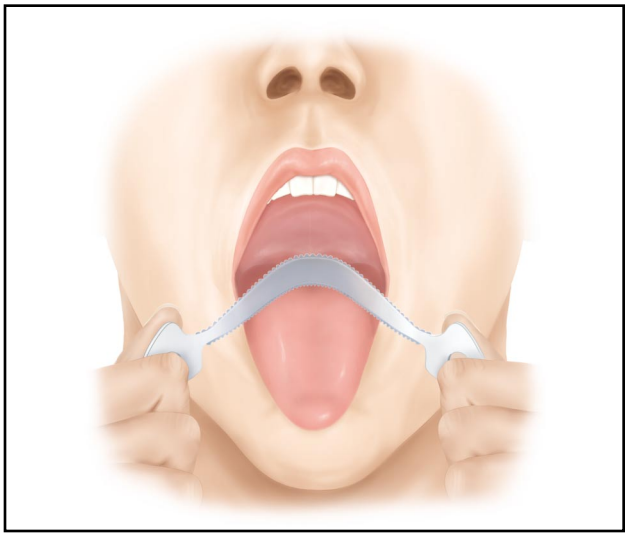


Figure 3. Use of a tongue scraper can facilitate adequate cleaning of the tongue.

Figure 4. Brushes specifically designed for the tongue have shorter, firmer bristles (Dr. Wieder's Original Tung Brush™, Peak Enterprises, Inc., Sarasota, FL). *(Used with permission of Peak Enterprises, Inc.)*

change in the sulcus is indicated by a red, yellow, or green light that is easily understood by the patient, who inherently knows that a rise in temperature is associated with a disease process.

It is important to determine if halitosis is real or imaginary, chronic or transitory. A personal history of the onset and duration of bad breath must be established. Consultation with family or close friends will confirm the presence, absence, or any patterns associated with the production of offensive odors emitting from the mouth. Accurate diagnosis of oral malodor is difficult. Presently, the most accurate mechanism is gas chromatography, which is not practical for the dental office due to the expense and size of the equipment.

Unfortunately, both the senses of smell and taste vary widely among individuals, and are subjective assessments. To objectively measure the presence of VSC, the Halimeter (Interscan Corporation, Chatsworth, CA) (Figure 2) may be helpful. A disposable straw is placed at the posterior dorsum of the tongue and the patient is asked not to breathe while the machine records the reading. It is the general consensus that a reading above 75 is malodor and below 75 is not. The Halimeter is lightweight and portable, and gives a digital readout in less than 30 seconds. As the calibration of the instrument is determined with hydrogen sulfide, a negative reading may occur if the malodor is caused by methyl mercaptan. Due to the sensitivity of the machine, patients should be asked not to wear colognes and not to eat or drink for a minimum of 2 hours before testing with the Halimeter.

It is suggested that nasal readings be taken with the Halimeter as well. This can help differentiate between the amount of odor that is generated by the mouth and the nose. Usually, the nose reading is not over 30 on the Halimeter, which is generally considered insignificant.

Organoleptic measurements (those taken and recorded by human sensory judges) have been quantified in relation to chromatography. A gauze square is placed on the dorsum of the tongue and firmly moved over the coating. The gauze square is smelled with the operator's head turned away from the patient's mouth to avoid air contamination. Using a Lichert scale of 1 through 5, with 1 being minimal and 5 being strong, the odor is recorded.

THE CLOSE RELATIONSHIP BETWEEN ORAL MALODOR AND DISEASE MUST BE TAKEN INTO CONSIDERATION IN THE DIAGNOSIS AND TREATMENT OF BAD BREATH.

TREATMENT

The challenge of therapy is twofold: remove the cause, and support therapy on a daily basis with dental products that eliminate VSC, such as tongue brushes, tongue scrapers, specialty toothpastes, gels, and rinses. Many individual products to alleviate halitosis are available directly to the consumer, while other complete treatment systems are available only through dental offices (e.g., Breath R_X™, Discus Dental™, Beverly Hills, CA; Retardex® Oral Rinse, Retardent® Toothpaste, Rowpar® Pharmaceuticals, Scottsdale, AZ).

The patient should be instructed in complete oral hygiene, including thorough removal of plaque from the surfaces of the teeth, with emphasis on the critical junction between the teeth and gingival margins. Special attention should also be given to cleansing of the tongue. A spoon, used with the concave surface facing the tongue, might adequately remove any coating. The many tongue scrapers available commercially follow two basic designs: a small, serrated-edge, flexible blade that can be curved to fit the tongue (e.g., Breath R_X™ Gentle Tongue Scraper, Discus Dental™, Beverly Hills, CA; Oolitt™, D.T. Corporation, Tampa, FL) (Figure 3); and a rigid fan-shaped device on a handle (e.g., Pickleen™, Alwin Enterprises, Salisbury, MD; Tongue Cleaner, Rowpar® Pharmaceuticals, Scottsdale, AZ). A firm pressure should be applied to the tongue scraper, as the white coating may be thick and tenacious. The patient should be instructed to avoid overzealous efforts, which may lead to soreness or bleeding of the tongue. Another difficulty the patient may encounter is that the tongue coating may be located on the extreme posterior portion of the dorsum of the tongue, which triggers a gag reflex when removal is attempted. Careful and consistent pressure should be applied.

The patient should thoroughly cleanse the tongue to remove any coating twice daily. The tongue is then brushed using a specialized toothpaste, which contains chlorine dioxide (Retardent® Toothpaste, Rowpar® Pharmaceuticals, Scottsdale, AZ), or tongue gel (e.g., Dr. Wieder's

Table

	Possible Medical Causes of Halitosis	Possible Drug Causes of Halitosis
Respiratory	Sinusitis Tuberculosis Emphysema Tonsillitis Tumors Pharyngitis Pneumonia Bronchitis	DMSO Amyl Nitrite Chloral Hydrate Paraldehyde Metronidazole Antidepressants Antiparkinsonians Antipsychotics Narcotics Decongestants Antihistamines Antihypertensives Anticholinergics
Liver	Liver Failure Liver Cirrhosis Gall Bladder Disease	
Kidney	Uremia	
Gastrointestinal	Esophageal Reflux Hiatal Hernia Stomach Cancer Malabsorption	
Systemic	Diabetes	

Table courtesy of Dr. Richard Miller.

Original Tung Gel™, Peak Enterprises, Inc., Sarasota, FL; Breath R_x™ Tongue Conditioning Gel, Discus Dental™, Beverly Hills, CA). Brushes specifically designed for the tongue, with shorter, firmer bristles (e.g., Breath R_x™ Gentle Oral Brush, Discus Dental™, Beverly Hills, CA; Dr. Wieder's Original Tung Brush™, Peak Enterprises, Inc., Sarasota, FL) are available. Next, the patient should apply the toothpaste or gel to the interproximal areas using a Monojet 412 impression syringe (Sherwood, St. Louis, MO). The patient should then floss, directing the paste into the gingival sulcus, and brush the teeth thoroughly.

Following cleansing of the tongue, brushing, and flossing, the patient should swish with a nonalcoholic, antihalitosis mouth rinse for 30 seconds, forcing the fluid between the teeth and around the mouth to cover all the oral tissues. A second application of mouth rinse gives complete coverage to the back of the mouth, the dorsum of the tongue, and the back of the throat. A nonalcoholic mouth rinse (e.g., Rembrandt® Oral Rinse, Den-Mat Corporation, Santa Maria, CA; Retardex® Oral Rinse, Rowpar® Pharmaceuticals, Scottsdale, AZ) should be used, as alcohol burns and dries the oral tissues and contributes to the problem.[9] Chlorine dioxide (ClO_2) rinses (e.g., Retardex® Oral Rinse, Rowpar® Pharmaceuticals, Scottsdale, AZ) offer substantial promise to eliminate bad breath at its source. Chlorine dioxide is a highly effective deodorizing and oxidizing agent that has been used extensively in water treatment, agriculture, and the dairy industry. Another rinse specifically developed to alleviate malodor contains zinc chloride, thymol, and eucalyptus oil (Breath R_x™ Cleansing Mouth Rinse, Discus Dental™, Beverly Hills, CA).

Recent research shows that a ClO_2 rinse (Retardex® Oral Rinse, Rowpar® Pharmaceuticals, Scottsdale, AZ) oxidatively consumes cysteine and methionine, the precursors of hydrogen sulfide and methyl mercaptan.[15] Additional research shows that these products contribute to an improvement in oral wellness between visits to the dental office by reducing periodontal probing depths and bleeding on probing.[16, 17] These studies support the role that VSC play in the permeability of the epithelial barrier and the advancement of the periodontal lesion.

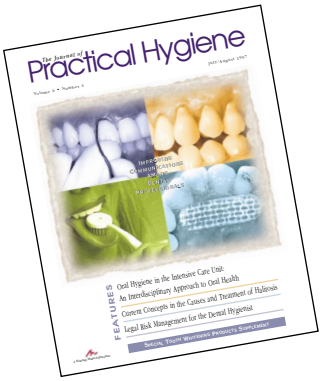
A follow-up appointment is recommended in 1 month. At this appointment, all diagnostic tests, including organoleptic testing and Halimeter readings, should be repeated to determine the progress of the treatment. Miller and Richter have both reported successful treatment using these simple, yet effective, procedures for the treatment of bad breath.[9, 12]

CONCLUSION

The dental professional is in an excellent position to recognize halitosis and make recommendations regarding its source and treatment. This social problem is often misunderstood, and masked with flavoring agents that provide short-term relief. The "old wives' tales" associated with the origins of halitosis should be dispelled, and diagnosis and treatment administered based on scientific research. The elimination of oral malodor may contribute to an overall increase in oral wellness. With 90% of all oral malodor sourced to the mouth,[9] the dental hygienist is in a valuable position to guide the patient to an odor-free mouth and a more positive self-image.

REFERENCES

1. Tonzetich J, Richter VJ. Evaluation of volatile odoriferous components of saliva. Arch Oral Biol 1964;9:39-46.
2. Tonzetich J. Oral malodor: An indicator of health status and oral cleanliness. Int Dent J 1978;28(3):309-319.
3. Yaegaki K, Sanada K. Biochemical and clinical factors influencing oral malodor in periodontal patients. J Perio 1992;63(9):783-789.
4. Tonzetich J, Ng SK. Reduction of oral malodor by oral cleansing procedures. Oral Surg Oral Med Oral Path 1976;42:172-181.
5. Rizzo A. The possible role of hydrogen sulfide in human periodontal disease. J Perio 1967; 5:233-236.
6. Ng W, Tonzetich J. Effect of hydrogen sulfide and methyl mercaptan on the permeability of the oral mucosa. J Dent Res 1984;63:994-997.
7. Tonzetich J, Yaegaki K, Coil JM. Collagen metabolism by fibroblast cultures in the presence of methyl mercaptan. J Dent Res 1986 (Special Issue);543(Abstract).
8. Kleinberg I, Westbay G. Salivary and metabolic factors involved in oral malodor formation. J Perio 1992;63:768-775.
9. Miller RA. Beating Bad Breath. Baltimore, MD: American Literary Press, Inc., 1995;2.
10. Iwakura M, Yasuno Y, Shimura M, Sakamoto S. Clinical characteristics of halitosis: Differences in two patient groups with primary and secondary complaints of halitosis. J Dent Res 1994;73(9):1568-1574.
11. Rosenberg M. Bad Breath: Research Perspectives. Tel Aviv, Israel: Ramot Publishing—Tel Aviv University; 1995:9.
12. Richter J. Diagnosis and treatment of halitosis. Comp 1996;17(4):370-388.
13. Fedi PF Jr, Killoy WJ. Temperature differences at periodontal sites in health and disease. J Periodontol 1992;63(1):24-27.
14. Niederman R, Naleway C, Lu B-Y, et al. Subgingival temperature as a gingival inflammatory indicator. J Clin Periodontol 1995;22:804-809.
15. Lynch E, Sheerin A, Claxson AWD, et al. Multicomponent spectroscopic investigations of salivary antioxidant consumption by an oral rinse preparation containing the stable free radical species chlorine dioxide (ClO_2). Free Rad Res 1997;26(3):209-234.
16. Chapek C, Reed OK, Ratcliff PA. Management of periodontitis with oral care products. Comp 1994;15(6):740-746.
17. Chapek C, Reed OK, Ratcliff PA. Reduction of bleeding on probing with oral-care products. Comp 1995;16(2):188-196.



To submit your CE Exercise answers, please use the enclosed Answer Card found opposite page 64, and complete it as follows: 1) Complete the address; 2) Identify the Article/Exercise Number; 3) Place an x in the appropriate answer box for each question. Return the completed card to the indicated address.

The 10 multiple-choice questions for this CE exercise are based on the article "Current Concepts in the Causes and Treatment of Halitosis" by Roberta Ratcliff, RDH, MBA. This article is on pages 47-50. Answers for this exercise will be published in the September/October 1997 issue of *The Journal of Practical Hygiene.*

4

UTHSCSA

ADA C·E·R·P
CONTINUING EDUCATION RECOGNITION PROGRAM

Learning Outcomes:

- **Cite the causes of halitosis.**
- **Cite factors that can contribute to halitosis.**
- **Describe the treatments of halitosis.**

1. To what did Hippocrates attribute halitosis?

A. Xerostomia.
B. Gastrointestinal disorders.
C. Recurring mouth sores.
D. Periodontal disease.

2. What is primarily responsible for oral malodor?

A. Gastrointestinal bacteria.
B. Volatile sulfur compounds.
C. Lesions of the oral mucosa.
D. Oral pathogens.

3. What is necessary for the continuous production of halitosis?

A. Plaque.
B. Irritation of the gingival sulcus.
C. Bacteria, saliva, and proteins.
D. White coating on the dorsum of the tongue.

4. A healthy mouth has a slightly alkaline pH.

A. True.
B. False.

5. What is the maximum percentage of oral malodor attributed to the oral cavity?

A. 60%.
B. 70%.
C. 80%.
D. 90%.

6. What is the primary site of volatile sulfur compound production?

A. The gingival sulcus.
B. The anterior wall of the pharynx.
C. The roof of the mouth.
D. The dorsum of the tongue.

7. Which of the following has not been associated with halitosis?

A. Xerostomia.
B. Poor oral hygiene.
C. Insomnia.
D. Drug ingestion.

8. What dental product ingredient can contribute to halitosis?

A. Fluoride.
B. Alcohol.
C. Lidocaine.
D. Chlorhexidine.

9. What has shown substantial promise to eliminate bad breath at its source?

A. Sodium fluoride.
B. Chlorine dioxide.
C. Hydrogen peroxide.
D. Zinc chloride.

10. How often should a halitosis patient thoroughly cleanse the tongue?

A. Once a day.
B. Twice a day.
C. Three times a day.
D. Four times a day.