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Review Article

Halitosis: A Crippling Social Problem

Dr. Baljeet Singh, [1] Dr. Avnika Garg, [2] Dr. Rahul K. Garg, [3]

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Affiliation:

1. Professor & Head, Department of Periodontology, Bhojia Dental College and Hospital, Baddi, H.P.
2. Post Graduate Student, Department of Periodontology, Bhojia Dental College and Hospital, Baddi, H.P.
3. MBBS, MBA(IIM Ahmadabad)

CORRESPONDING AUTHOR

Dr. Avnika Garg, Post Graduate Student, Department of Periodontology Bhojia Dental College and Hospital, Baddi, Himachal Pradesh, India.

Email: avnika_garg@yahoo.co.in

ABSTRACT

Bad breath or halitosis is the most common complaint reported to dental professionals. It is an oral health condition characterized by unpleasant odors emanating timely from the oral cavity. The origin of halitosis may be related both to oral and systemic conditions, though 85-90% of cases are of oral origin. Screening for and assessment of halitosis by dental hygienists, is not only practical but imperative in helping patients maintain overall health. As periodontists, we play an important role in detection, management and resolution of bad breath.

Keywords: Halitosis, Malodor, Volatile Organic Compounds (VOCs), Volatile Sulpfur Compounds (VSCs), Dimethyl Sulfide (DMS), Methyl Mercaptan (MM), Cetylpyridinium Chloride (CPC), Essential Oil (EO)

INTRODUCTION

Breath odor can be defined as the subjective perception after smelling someone's breath. If it is unpleasant, the terms breath malodor, halitosis, or bad breath can be applied. These terms, however, are not synonymous with oral malodor, which has its origin in the oral cavity.[1] The term oral malodor is used to describe a foul or offensive odor emanating from the oral cavity, in which proteolysis, metabolic products of the desquamating cell, and bacterial putrefaction are involved. Halitosis is the general term used to describe unpleasant breath, regardless of its sources, oral or non-oral.[2]

Halitosis is a crippling social problem with a common complaint of up to one-third of the general population. Halitosis is a lyrical term derived from the Latin word "halitus" (breath) and the Greek suffix "*osis*" (condition, action or pathological process). It is also called as fetor ex ore or fetor oris.[3] Halitosis is not a disease but rather a symptom of underlying oral, systemic or psychological conditions.[4] Current social norms emphasize the importance of personal image and interpersonal relationships. Thus, halitosis may be an important factor in social communication and, therefore, may be the origin of concern not only for a possible health condition but also for frequent psychological alterations leading to social and personal isolation.[5] It can be an awkward and embarrassing problem for millions, and can be a warning sign of

medical and dental disease. So, research on its diagnosis, etiology, and treatment are of prime importance.[6]

HISTORY

The references of oral malodor have been found in scripts of *Eber papyrus* as early as 1550 B.C., and in the Talmud (a book containing ancient Jewish civil and religious law). Hippocrates (460-400 B.C.) had developed a mouthwash of unadulterated wine, anise, dill seed and myrtle. Maccius Platus (254-184 B.C.) a Roman dramatist who was sufficiently offended by his wife's halitosis to find it just cause for infidelity. In 19th century Joseph Howe, a physician, introduced his well-written and informative book. He believed that halitosis was the result of sulphuretted hydrogen, which is found in great abundance in the intestinal canal as well as in decayed teeth, dead teeth and inflamed gums. He also postulated that stress, in the form of fear, excitement or tension may sufficiently alter the body systems to produce a disagreeable breath odor.[7]

EPIDEMIOLOGY

Epidemiological data is difficult to evaluate due to the subjective self evaluation of breath malodor. However, it does suggest that breath malodor is common, not age related and that men are more than three times at risk of oral malodour than women.[8] Atleast 50% of the population suffer from chronic oral malodor and approximately half of these individuals experience a severe problem that creates personal discomfort and social embarrassment.[9]

In the vast majority (85%) the cause originated from the oral cavity. Gingivitis, periodontitis, and tongue coating were the predominant causative factors. Because more than 90% of the population has gingivitis or periodontitis, there is a risk that a plaque-related inflammatory condition is too easily considered the cause while more important pathologies are overlooked. Indeed, for a minority of patients, extra-oral causes can be identified, including ear-nose-throat (ENT) pathology, systemic diseases (e.g., diabetes), metabolic or hormonal problems, and hepatic or renal insufficiency, bronchial carcinoma, or gastro-enterologic pathology. In a special patient category, subjects imagine they have breath malodor; this is called *imaginary breath odor or halitophobia.* The latter has been associated with obsessive-compulsive disorders and hypochondria.[1]

CLASSIFICATION

Halitosis can be subdivided into: real/genuine halitosis, pseudo-halitosis [10] and halitophobia (Yaegaki and Coil, 2000)[11]

Genuine/ Real/True halitosis

Real halitosis can be further subdivided into physiological and pathological halitosis.[7] *Physiological halitosis*: It occurs through digestive processes in the GI tract or through normal putrefactive processes in oral cavity and is not associated to systemic disease or any pathology.[11] Physiologic halitosis includes halitosis caused by dietary components (garlic, onion,spices, alcohol), deleterious habits like smoking, morning breath, secondary to xerostomia caused by physiologic factors.[7]

Pathologic halitosis: It may have intra-oral and extra-oral etiology.[11] The causes of pathologic halitosis can both be intraoral (90%) as well as extraoral (10%),[3] and is determined by the source of the odor.[12] Intra-oral causes include gingival and periodontal diseases like periodontitis, acute necrotizing ulcerative gingivitis, residual post-operative blood, debris under dental appliances, ulcerative lesions of the oral cavity. Halitosis may be associated with coated tongue, may occur due to xerostomia secondary to salivary gland diseases, tonsilloliths.[7] Only about 10% to 20% of halitosis is of

extraoral origin and can originate from organs in proximity to or remote from the oral cavity, and many of them have a characteristic odor.[4] *Tangerman* and *Winkel* divided extra oral halitosis into blood borne and non blood borne categories and stressed the importance of clinically differentiating between the two. Blood borne extra oral halitosis occurs when volatile organic compounds (VOCs) - produced by degradation through the body's endogenous metabolic processes—enter the blood stream and travel to the lungs. It is in the alveoli of the lungs that a blood gas exchange occurs and the VOCs are fractioned and expelled through exhalation. Non blood borne extra oral halitosis can originate from the nose, the upper and lower respiratory tracts, the gastrointestinal tract, or a combination of any of these, and is attributable to disease or disorders in these areas.[12]

Pseudohalitosis

Patients who suffer from pseudohalitosis complain of the existence of halitosis though it is not perceived by others. This condition can be managed effectively by counseling (using literature support, education and explanation of examination results) and simple oral hygiene measures.

Halitophobia

Some individuals continue to insist that they have halitosis even after they have been treated for genuine or pseudo-halitosis. Such individuals are categorized as halitophobic.[7] It is a condition in which the patient has an exaggerated fear of having halitosis; those affected may or may not have a previous history of having genuine halitosis. This form of halitosis has also been referred to as delusional halitosis and is considered a variant of monosymptomatic hypochondriacal psychosis (MHP). The halitophobics are obsessive about oral health, and often use odour-masking techniques. In the severe form, halitophobics extract all their teeth, isolate themselves and may even commit suicide.[4]

ETIOLOGY OF ORAL MALODOR

The unpleasant smell of breath mainly originates from volatile sulfide compounds *(VSCs),* especially hydrogen sulfide (H2S), methylmercaptan (CH3SH), and dimethylsulfide [(CH3)2S], as first discovered by Tonzetich.[1] They are all thiols; containing a characteristic –SH group which is formed when the oxygen atom in hydroxyl group is replaced by sulfur. Oral thiols are toxic biproducts of gram negative anaerobic bacterial metabolism of sulfur containing amino acids (cysteine, cysteine and methionine) that reside in saliva, GCF, the gingival and periodontal pocket and tongue surface. This bacterial metabolism is of putrefactive nature and leads to oxygen depletion.[7] Other compounds in mouth air may also be offensive, such as diamines (e.g., putrescine, cadaverine), indole, skatole, and butyric or propionic acid.[1] Methyl mercaptan (MM) appears to be the main culprit of intra-oral halitosis, whereas patients with extra-oral halitosis present with elevated levels of dimethyl sulfide (DMS), often indicating an underlying medical disorder.[12]

When hormonal, gastrointestinal, renal, or metabolic pathologies are the cause, additional malodorous molecules can be produced; these circulate in the blood and are expressed through the expired air or the GCF. It is important to consider not only the unpleasantness of the odor of the molecule itself, but also its substantivity and dilution capacity. Most malodorous compounds express themselves only when they become volatile, a phenomenon similar to the perception of perfumes.[1]

It has been demonstrated that the intensity of clinical bad breath is significantly associated with amount of intra-oral VSC level. The periodontal pocket is an ideal environment for VSC production with respect to the bacterial profile and sulfur source. In addition, VSC

also accelerate periodontal tissue destruction. This may explain why patients with periodontal diseases often complaint of oral malodor.[2] In contrast to VSC in mouth air where hydrogen sulfide is present in greatest concentrations, it has been demonstrated that methyl mercaptan is often predominant compound in periodontal pocket and its presence in a pocket indicate active periodontal disease.[13] Three oral bacterial species highly associated with periodontal disease- *Porphyromonas gingivalis, Treponema denticola and Bacteroides forsythus*- are among the most active VSC producers in vitro.[14]

Reduced salivary flow rate and stagnation of saliva also contribute to bacterial shift and oral malodor formation. In addition, saliva in a slightly alkaline condition produces typical odor, while slightly acidic saliva has the opposite effect. An acid ph prevents the formation of odorous metabolic end products by inactivating the enzymes required for the putrefaction of amino acids and several amino acids favors alkalinity when the ph is acidic. Oxygen depletion in saliva/plaque also plays a complex but important role in malodor formation. Oxygen depletion is a significant factor in determining the extent to which the oxidation-reduction potential (E_h) falls during amino acid degradation. This is an important way to determine which kinds of bacteria can grow and whether oral putrefaction and malodor may occur. Therefore, oxygen depletion and its availability may control the types of odoriferous compounds.[2]High protein proportion in saliva aids in the production of VSCs which is the major cause of halitosis.[11]

Theories of Malodor

In common with caries and periodontal disease, two theories of microbial etiology can be proposed: a "specific theory" (that just a few 'single' species are etiological and capable of causing malodor; their presence solely will explain malodor) and a "nonspecific theory", which suggests that many species (most being strict anaerobes) have the ability to bio-transform substrates into volatile compounds or volatile sulfur compounds and that many groups can therefore substitute for others; there is no single causative species. However, it is probably the microbial load that best predicts the total levels of bio-transforming enzymes (and bio-transforming microenvironments) found in the mouth.[15]

DIAGNOSIS OF MALODOR

Medical History

The proper diagnostic approach to a malodor patient starts with a thorough questioning about the medical history. The clinician should ask about the frequency (e.g., every month), time of appearance within the day (e.g., after meals can indicate a stomach hernia), whether others (non-confidants) have identified the problem (excludes imaginary breath odor), what medications are taken, and whether the patient has dryness of the mouth or other symptoms.

Self Examination

It can be worthwhile to involve the patient in monitoring the results of therapy by self examination, especially when an intraoral cause has been identified. The following self-testing can be used: smelling a metallic or non-odorous plastic spoon after scraping the back of the tongue, smelling a toothpick after introducing it in an interdental area, and smelling saliva spit in a small cup or spoon.[1]

Organoleptic Rating/ Sniffing method

It is a sensory test scored on the basis of the examiner's perception of a subject's oral malodor.[3] The use of organoleptic measurement is suggested as the "gold standard".[15] In organoleptic evaluation, a trained "judge" sniffs the expired air and assesses whether or not this is unpleasant using an intensity rating, normally from 0 to 5, as proposed by Rosenberg and McCulloch[1]

(Rosenberg scale), and the offensiveness on a hedonic scale (-2 to +2).[12] It is solely based on the olfactory organs of the clinician:

- 0 = no odor present,
- 1 = barely noticeable odor,
- 2 = slight but clearly noticeable odor,
- 3 = moderate odor,
- 4 = strong offensive odor, and
- 5 = extremely foul odor.[1]

Demerits: Each judge participating won't be able to make equivalent comparison and when we are repeatedly exposed to a bad odor our sense of smell acclimates to the odor and therefore loses much of its sensitivity. Bad breath that was exceedingly objectionable at the beginning, may seem quite less as the evaluation continues.[7]

Portable Volatile Sulfide Monitor

This electronic device **(Halimeter, Interscan, Chatsworth, Calif)** analyzes the concentration of hydrogen sulfide and methylmercaptan, but without discriminating them.[1] Therefore they are incapable of detecting extra-oral blood borne halitosis.[12] Additionally compounds such as ethanol (alcohol) and essential oils (both of which are found in mouthwashes) interfere with halimeters ability to make a measurement. But it has many advantages as it requires no special training to use, is portable, measurements can be made quickly and apparatus is comparatively inexpensive. It can be used for follow ups, psychological support during treatment and many patients trust the result of a device more than dentists nose.[7]

Gas Chromatography

It was used by *Joseph Tonzetich et al* in 1970's.[16] Elaborate gas chromatography is only available in specialized centers but is especially useful for identifying non-oral causes.[1] It is the ideal assessment device as this highly specialized precise piece of equipment not only detects H2S, MM and DMS but also has the unique ability to differentiate between the three compounds. But it also has limitations in that the unit is not portable, the test is time consuming to perform and requires a skilled operator, thereby, making it ill suited for routine dental use. A portable version of a gas chromatographer called Oral Chroma™ (FiS Inc. Itami-Shi, Hyogo, Japan) is developed having the same capabilities and accuracy of a standard chromatograph. Because it is used chairside, patients are able to view their chromatograph results via a monitor and receive a printed version of their chromatogram.[12]

Dark Field or Phase Contrast Microscopy

Gingivitis and periodontitis are typically associated with a higher incidence of motile organisms and spirochetes, so shifts in these proportions allow monitoring of therapeutic progress. Another advantage of direct microscopy is that the patient becomes aware of bacteria being present in plaque, tongue coating, and saliva. Too often, patients confuse plaque with food remnants. High proportions of spirochetes in plaque have been associated with a specific acidic malodor.

Saliva Incubation Test

The analysis of the headspace above incubated saliva by gas chromatography reveals *hydrogen sulfide, methylmercaptan, dimethylsulfide, indole, skatole*, lactic acid, *methylamine, diphenylamine, cadaverine*, putrescine, urea, ammonia, *dodecanol, tetradecanol,* and others. The components in italics are elevated in the presence of periodontitis, although this does not necessarily prove they play a role in odor production. By adding some proteins, such as lysine or cysteine, the production of cadaverine or hydrogen sulfide is dramatically increased. Organoleptic evaluation of the saliva headspace offers promising perspectives for

monitoring treatment results. It is a less invasive test, especially for the patient, than smelling breath in front of the oral cavity.[1]

Electronic Nose

Latest developments lead to the so-called electronic or "artificial noses", which are supposed to provide quantification and classification of exact smells.[10] An artificial nose that has the same capacities as the human nose would be ideal.[1] Originally these devices have been developed for quantitative assessments of smells in food or beverages. However, an application to diagnosis of halitosis appears reasonable.[10]

The BANA Test

Bacteria that produce bad breath can be detected by performing BANA test. Bacteria, in question have the characteristic of being able to produce an enzyme that degrades the compound BANA (benzoyl-D, L-arginine-napthylamide). When sample of patient's saliva that contains these bacteria is placed in the BANA testing compound, they cause it to break down. As a result, the testing compound changes color.

Utilizing Chemiluminescence

One of the most recent methods for detecting the compounds associated with bad breath. Method was introduced in 1999. When a sample containing sulfur compound is mixed with the tests mercury compound, the resulting reaction causes fluorescence. Thus it provides better selectivity and sensitivity when measuring low levels of sulfur compounds as compared to halimeters.

Zinc oxide and Nitrogen chemiluminescence detectors

These chemiluminescence detectors permit the precise measurement of nitrogen compounds such as indole & cadaverine in organic matrices. This helps to determine whether these nitrogen compounds are present in mouth air.[7]

TREATMENT OF ORAL MALODOR

Treatment consists of identifying, eliminating or managing the causal predisposing and modifiable factors.[12] ***Miyazaki et al* (1999)**[9] established the recommended examination for halitosis and a classification of halitosis with corresponding treatment needs. Accordingly, different treatment needs (TN) have been described for the various diagnostic categories (Table 1). The responsibility for the treatment of physiologic halitosis (TN-1), oral pathologic halitosis (TN-1 and TN-2), and pseudo-halitosis (TN-1 and TN-4) resides on dental practitioners. However, extra-oral pathologic halitosis (TN-3) and halitophobia (TN-5) should be managed by a physician or medical specialist and a psychiatrist or psychological specialist.[9]

Table 1: Five categories of Treatment Needs (TN) for breath malodor

TN-1	Explanation of halitosis and instructions for oral hygiene (support and reinforcement of a patient's own self care for further improvement of his or her oral hygiene)
TN-2	Oral prophylaxis, professional, cleaning and treatment of oral diseases, especially periodontal disease.
TN-3	Referral to a physician or medical specialist.
TN-4	Explanation of examination data, further professional instruction, education and reassurance.
TN-5	Referral to a clinical psychologist, psychiatrist or other psychological specialist.

Treatment of malodor should not be considered as just cosmetic therapy e.g. mouthwashes etc, since the available evidence indicates that many members of the VSC family are toxic to periodontal tissues even when present at extremely low concentrations.[13] Because oral malodor is caused by the metabolic degradation of available proteins to malodorous gases by certain oral microorganisms, the following general treatment strategies can be applied:

- Mechanical reduction of intraoral nutrients and microorganisms
- Chemical reduction of oral microbial load
- Rendering malodorous gases nonvolatile
- Masking the malodor

Mechanical Reduction of Intraoral Nutrients and Microorganisms

Because of the extensive accumulation of bacteria on the dorsum of the tongue, tongue cleaning has been emphasized. Cleansing of the tongue can be carried out with a normal toothbrush, but preferably with a tongue scraper if a coating is established. Tongue cleaning has the additional benefit of improving taste sensation.[1] The plaque forming potential of *Streptococcus salivarius* percentage is also decreased following tongue brushing.[3] Interdental cleaning and tooth brushing are essential mechanical means of dental plaque control.[1] However, some clinical studies revealed that brushing the teeth exclusively was not very effective in reducing oral malodor scores.[9] Because periodontitis causes chronic oral malodor, professional periodontal therapy is needed.

Chemical Reduction of Oral Microbial Load

Mouth rinsing has become a common practice in patients with oral malodor. The active ingredients in oral rinses are usually antimicrobial agents such as chlorhexidine, cetyl-pyridinium chloride (CPC), essential oils, chlorine dioxide, hydrogen peroxide, and triclosan. All these agents have only a temporary reducing effect on the total number of microorganisms in the oral cavity. ***Halita***, a new solution (0.05% chlorhexidine, 0.05% CPC, 0.14% zinc lactate, no alcohol) has been even more efficient than chlorhexidine alone, suggesting that the other compounds are also important. This is explained by a synergistic effect between chlorhexidine and CPC on one hand and by the Zn++ on the other hand.[1]

Most commercial products claim to effectively eliminate mouth odor. However, they only mask oral malodor by the use of strongly flavored solutions in an alcohol base; therefore often act as a temporary relief rather than a permanent cure. These mouthwashes may actually accelerate oral malodor because of the drying effect caused by the high alcohol content. Patients should be instructed to stop using any mouth rinses containing alcohol as part of the treatment plan to eliminate oral malodor.[2]

Many natural products like yogurt, lemon water, mint leaves, vinegar, and cardamom seeds are beneficial in curing bad breath. *Lodhia P* et al (2008) have shown significant effectiveness of green tea in reducing oral malodor because of its disinfectant and deodorant activities, although effect was maintained for a very short duration. Green tea was found even more effective than sugarless chewing gum and mint in reducing volatile sulphur compounds.[7]

Conversion of Volatile Sulfide Compounds

Metals such as zinc, sodium, tin and magnesium are thought to interact with sulfur. They bind to the metal ions and oxidize the thiol groups in the precursors of VSC compounds. Unfortunately, both cupric and stannous ions have the potential to discolor teeth, which can be attributed to as a result of sulfide formation on the teeth after extended periods of use or due to the precipitation of dietary chromogen. Zinc is the metal ion of choice with this purpose because of its low toxicity and its other favorable properties, such as not causing

dental staining.[5]

Baking soda dentifrices have been shown to be effective, with a 44% reduction of VSC levels 3 hours after tooth brushing versus a 31% reduction for a fluoride dentifrice. The mechanisms by which baking soda produces its inhibition of oral malodor might be related to its bactericidal effects and its transformation of VSCs to a nonvolatile state.

Masking the Malodor

Treatments with rinses, mouth sprays, and lozenges containing volatiles with a pleasant odor have only a short-term effect. Another pathway is to increase the solubility of malodorous compounds in the saliva by lowering the pH of the saliva (low pH increases the solubility of VSCs) or simply increase the secretion of saliva; a larger volume allows the retention of larger volumes of soluble VSCs. The latter can also be achieved by ensuring a proper liquid intake or by using a chewing gum; chewing triggers the periodontal-parotid reflex, at least when the lower (pre)molars are still present. To lower the pH, an orange juice may be sufficient, but the effect is short term.[1]

SUMMARY

The dental research community has long ignored the subject of oral malodor. Recently, along with the growing public and media interest in oral malodor, dental professionals are becoming more aware of their patients' concern/needs. Thus a proper diagnosis and determination of the etiology allow initiation of the proper etiologic treatment. It is our hope that future studies will overcome the difficulty of diagnosing this long standing problem and provide effective treatments to relieve individuals who suffer from oral malodor.

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