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Review Article

Oral Malodor as a Health and Social Problem

Najwa Nassrawin*, DDS, MS and Nabil F. Bissada, DDS, MSD

Royal Medical Services, Jordan

*Corresponding author: Dr. Najwa Nassrawin, P.O Box 1438 Al Jubieha, Amman 11941 Jordan, Tel: 00962795041388;

Email: najwanass@yahoo.com

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Abstract

Oral malodor is a serious problem that makes subjects who suffer from it subjected to adverse health and embarrassing consequences. Oral malodor may lead to significant personal discomfort and social embarrassment. The aim of this article is to provide a comprehensive review of this condition including: oral malodor examination protocol, causes, prevalence, methods of diagnosis and proposed treatment options.

Material and Methods

A midline search was conducted on many articles that discuss oral malodor.

Conclusion

The current review revealed the importance of the proper diagnosis and so the appropriate therapy could be achieved.

Keywords: Oral Malodor; Causes; Diagnosis and Treatment.

Introduction

Oral malodor (OM) describes an unpleasant or offensive odor emanating from the oral cavity [1]. Individuals who suffer from this condition often are subjected to adverse health and embarrassing social consequences as well as impediments to interpersonal relationships and life style [2]. Current research recognizes the complex and challenging spectrum of both medical and psychological issues related to treatment of chronic oral malodor.

Objectionable odor emanating from the mouth mainly is based on hydrogen sulfide, methyl mercaptan, and dimethyl sulfide [3]. These are produced by the interaction of Gram-negative bacteria and food debris, cells, saliva, and blood within the oral cavity, resulting in the decarboxylation of cysteine, cystine, and methionine [4-7].

Prevalence of Oral Malodor

Although studies on the prevalence of chronic OM have become more frequent in the last 20 years, the different criteria and methods of diagnosis lead to significant apparent variations in the prevalence of this condition among different populations. Currently, there are no universally accepted standard criteria defining OM [8,9]. Differences in how chronic OM is perceived also vary among culturally-diverse populations (Table 1).

However; persistent OM statistically is prevalent among people more than 20-years-old [20]. Although there is no difference in relation to gender [18,20,21], the level of volatile sulfide compounds (VSCs) in mouth air is significantly lower in 78% of males experiencing bad breath after waking up versus that in females [14,19]. Also it has been reported some changes in the level of volatile sulfur compounds during pregnancy and menstrual cycle especially if the women has periodontitis [22].

Table 1. Prevalence of OM by Country.

Country	Author(s)	Method	Percentage (%)
Japan	Miyazaki et al. [10]	Patients complaining of OM	24
USA	Van Stenberg et al. [11]	Morning OM	50
France	Frexinos et al. [12]	Population reporting having OM	22
Swede	Söder et al 2000 [13]	Organoleptic score	2.4
KSA	Almas et al. [14]	Self-perception	44% males, 32% females
Nigeria	Arowojulo & Dousa [15]	Cases cross validity by examiner	14.5
Israel	Levin L & Rosenbergh [16]	Subjects told about OM	6.3
China	Liu et al. [17]	Organoleptic scan	27.5
India	Ashwath et al	Self-perception	44 % males, 45.32% females
Kuwait	Al-Annsari et al. 2006 [16]	Self-reported OM	23.3

Types of Oral Malodor

Oral malodor can be classified into three groups:

-Genuine halitosis which can be either physiologic halitosis (e.g morning halitosis) or fasting breath that is transient and self-limited, its common complaint. Estimates show perhaps one quarter of all adults suffer from malodor [23].

-Pathologic one that is due to pathological condition rather than a lack of consistent oral hygiene, which may be from oral origin like gingivitis, periodontitis, tongue coating (posterior dorsum of the tongue). Tongue surface is composed of blood components, nutrients, large amount of desquamated epithelial cells, studies indicates that the bacteria residing on the tongue make the dominant contribution to oral malodor [24,25] or decrease amount of saliva in case of xerostomia [26]. In addition it has been found that the increase in saliva viscosity increase the risk of having oral malodor [27]. Also oral related e.g tonsillitis, sinusitis and rhinitis, and it could be from extra-oral origin like gastrointestinal problems. It is reported that 87% of OM originates from oral sources [28].

In addition it has been found that the increase in saliva viscosity increase the risk of having oral malodor [27].

-Pseudo-halitosis: complains of oral malodor without the actual existence.

-Halitophobia: where there is fear of halitosis in the absence of objective oral malodor. . It may occurs as a symptoms in various psychologic disorder. It may also associated with anxiety [29].

Methods of OM Diagnosis

Self estimation can be used to judge one's own oral malodor [25]. but in case dental consultation dentist consultation, bad breath easily can be determined by either organoleptic or physio-chemical methods.

Organoleptic Method

This method of assessment can be performed by general dental practitioner, dental hygienist or general practitioner. The examiner uses the sense of smell to detect the patient's

oral odor, and ranks the intensity of the odor. A scoring system designed for this method is based on estimating the intensity of the exhaled odor on a scale of 0-to-5 points [20](Table 2). In order to better consider the overall results, patients and examiners follow the same instructions, such as the avoidance of coffee, tea, juice, smoking, and scented cosmetics. In addition, patients must stop using mouthwashes, breath fresher, and abstain from smoking for 12 hours before each assessment. Organoleptic scoring, however, is considered an uncomfortable procedure for testing OM for both the examiner and patient [30].

Table 2. Organoleptic scores.

0	No odor
1	Barely noticeable
2	Slight but clearly noticeable
3	Moderate odor
4	Strong odor
5	Extremely strong odor

Volatile Sulfur Compounds Measurement/Gas Chromatography

This laboratory-based procedure utilizes a flame photometer detector to reveal volatile sulfur compounds, primarily hydrogen sulfide (H_2S) and methyl mercaptan (CH_3SH), by analyzing the sulfur content of the subject's mouth air [31]. Although the results are precise and reliable but it takes long time to run, moreover; it is expensive and requires a skilled operator [32]. A sulfide monitor, developed in the 1990s, is convenient for use in the dental office. Unfortunately, this test underperforms in terms of detecting methyl mercaptan, a significant component of OM-related to periodontal disease [33].

Other sensors of volatile sulfur compounds, linked directly to the periodontal probes of specific areas, produce readings that compare significantly to the results produced by the organoleptic method [34]. Some of these techniques can be used to quantify and monitor changes of chronic OM [32].

Breathron

Breathron, a semiconductor of volatile sulfur compound (VSC) sensors, is a ZnO thick film filter lining a disposable mouthpiece [34]. This monitor digitally detects VSCs in the mouth. According to the manufacturer's instructions, subjects with VSC levels below 250ppb are classified as normal odor patients whereas those with levels above this threshold are classified as malodor patients [35,36].

Benzoyl-DLarginine-naphthylamide (BANA) Test

The BANA test is based on incubating samples wiped from the tongue with a cotton swab. It is test strip which composed of benzoyl-DLarginine-naphthylamide acting as a synthetic trypsin substrate [20]. This test is capable of determining the proteolytic activity of anaerobic organisms in the oral cavity such as *P gingivalis*, *T denticola*, and *B. forsythus*. If organisms have enzymes that degrade BANA, colored compounds that are either light or dark blue are produced within 5-to-15 minutes. The darker the color the higher the concentration and the greater the number of organisms [37]. There is a significant relationship between organoleptic and Halimeter measurements. Comparison of these methods can be used in diagnosis of halitosis with high accuracy[38].

Although these four test methods are helpful in monitoring gases that lead to OM, the organoleptic method still is the most commonly used test.

Treatment of Oral Malodor

Chronic OM is a multi-factorial problem that requires a well-defined approach to diagnosis and treatment [39]. Successful treatment begins with identifying both major and minor contributing factors. Ameliorated periodontal health and OM treatment can produce significantly improved clinical outcomes. The ultimate goal of treatment for OM is achieved by eliminating, or at least reducing, the causative microorganisms and associated substrates by an improvement in home-based oral hygiene procedures.

Although it is reported that dental prosthesis, uncontrolled periodontal disease, and other oral infections contribute to orally-generated OM [40], the ADA Council [37] recommended assessment of all oral diseases and conditions that may contribute to OM.

Because OM mostly is the result of an overgrowth of oral microorganisms, treatment should be aimed at reducing the number of such micro-organisms that produce offensive volatile sulfide compounds by [39].

- Oral hygiene instruction meant to reinforce brushing, flossing, tongue scraping, and cleaning of the removable dental appliances
- Professional tooth cleaning including thorough scaling and root planning
- Use of antiseptic mouthwash
- Evaluation and proper maintenance to maintain oral/periodontal health.

Either mechanical or chemical procedures can be used in

treatment. Oral hygiene procedures, such as tongue cleaning, are used for the mechanical reduction of micro-organisms [37]. In addition to tooth brushing and flossing, many studies reported the value of tongue cleaning procedures using a toothbrush or by scraping [40]. Chemical control of chronic OM is accomplished by antibacterial mouth washes and toothpastes recommended by a dentist as adjuncts to scaling and root planning [41].

After treatment, patients are instructed to follow a simple and inexpensive method at home to assess OM by using an odorfree plastic bag as an organoleptic self-assessment and as a cognitive behavioral treatment option for two-to-four weeks [42].

When physiologic OM originates from the dorso-posterior region of the tongue, instruction should be given on how to appropriately clean the tongue surface [43]. For excessive dryness of the mouth at night, patients are encouraged to drink ample amounts of water in the morning [42]. Physiologic OM, a transient problem, more easily can be controlled or influenced through education focused on the patient's oral hygiene behavior. The individual's eating habits should be checked to determine the association between a high protein diet or certain dietary features and oral malodor. A low-carbohydrate, high-protein diet is associated with oral malodor [31].

People with halitophobia often avoid social situations and are continually preoccupied with concealing the perceived odor by frequent brushing, continuous gum chewing and candy sucking keeping a safe distance or talking "talking sideways". Halitophobia is considered when no clinical findings support the patient's complaint that halitosis exists. In some instances, referring individuals to a clinical psychologist or psychiatrist should be considered [44]. Some patients, however, resist seeing a psychological specialist even when they acknowledge or understand that their problem is not explicitly dental in origin [29].

Mouthwash suggested for the treatment of OM usually reduces bacterial load or associated odoriferous compounds [45], e.g., chlorhexidine gluconate, triclosan, essential oils, zinc chloride, zinc acetate, and others. Chlorhexidine mouth wash was considered very effective in reducing oral malodor especially if it is combined with zinc (0.3%) or with benzydamine hydrochloride because of the synergistic effect of those two components [46,47]. Also it is reported that tooth paste containing triclosan provides fresh breath for up to 12 hours after brushing; and is accepted by the American Dental Association [48,49]. Chewing xylitol gum positively affects self-rated and objective oral health status by controlling oral hygiene under conditions that interfere with oral hygiene maintenance and that reflected on OM [50] (T. Hashiba et al. 2015). Farrell et al [51] recommended that combining therapeutic dentifrice, mouth rinse and tooth brushing are

efficient means of oral malodor reduction. Recently Aung and his colleagues 2015 [52] performed a study to compare different oral hygiene procedures on reduction of VSCs in subjects with OM and divided the volunteers into two groups. Both groups performed tooth brushing, mouth washing with chlorine dioxide, tongue cleaning and combination of those in different sequence for five weeks. Total VSCs of subjects were measured with Breathtron and oral health status was also examined. Significant reduction in VSCs were shown by adding mouthwash or tongue cleaning to tooth brushing from the second week to fourth week. The greatest reduction in VSCs was found at the fifth week after the practice of all three oral hygiene regimens. A novel option for treatment of oral malodor in adolescent is using photodynamic therapy, either with or without tongue scraper. An immediate effect with greatest reduction in volatile sulfur compounds when tongue scraper combined with photodynamic therapy [54].

Breathe-freshening, however, is considered cosmetic rather than medical-management of chronic OM. Pervasive media advertising and the accessibility of mouth-freshening products are the primary reason people use over-the-counter products for OM. Some products genuinely may be effective in reducing number of bacteria, whereas others simply may mask the problem. A patient's difficulty in discussing this problem, even with oral health providers, often is another motivating factor for the use of mouth-freshening products. As a part of oral hygiene regimen, the importance of mechanical tongue cleaning is emphasized because it reduces 52-75% of volatile sulfide compound (VSC) concentrations in the mouth air of periodontally-healthy individuals [55,56]. Also health education incorporating prevention of oral malodor as a motivation tool for oral health promotion could be valuable procedure to be included in high school dental health education [57].

Conclusion

Although there is no one solution related to the varying causes and implications of OM, practitioners can aim to reduce complications associated with OM through heightened awareness of the psychological and medical treatments such as breath clinics. Ultimately, dentists offer the best ability to assist patients in managing problems associated with OM by offering guidance on oral hygiene and opening the door to medical treatment if a non-oral cause is present. The patient should fully realize that the diagnosis of the cause of OM is essential for successful outcome of the treatment.

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