
Oral malodor in Special Care Patients: current knowledge

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KEYWORDS

Halitosis, Special Care Dentistry, Disability, Oral Hygiene.

ABSTRACT

Epidemiological studies report that about 50% of the population may have oral malodor with a strong social and psychological impact in their daily life. When intra-oral causes are excluded, referral to an appropriate medical specialist is paramount for management and treatment of extra-oral causes. The intra-oral causes of halitosis are highly common, and the dentist is the central clinician to diagnose and treat them. Pseudohalitosis or halitophobia may occur and an early identification of these conditions by the dentist is important in order to avoid unnecessary dental treatments for patients who need psychological or psychiatric therapy. The organoleptic technique is still considered the most reliable examination method to diagnose genuine halitosis. Special needs patients are more prone than others to have oral malodor because of concurrent systemic or metabolic diseases, and medications. The present report reviews halitosis, its implications, and the management in special care dentistry.

Introduction

Oral malodor, foetor ex ore, bromopnea or, more commonly, halitosis are generic terms used to identify a disagreeable odor emanating from the oral cavity and breath. Halitosis can affect all people regardless of gender and age (1, 2). Epidemiological data reveal that 50% of the population may have this problem, and in a few cases subjects may experience psychological and social repercussions (3–5). In the majority of patients halitosis has oral causes, but in some cases it may have either extra-oral causes related to systemic diseases, often called “blood borne halitosis”, or infections of the upper respiratory tract (6). Although halitosis often refers to a persistent condition which requires diagnosis and treatment, it can also be just a transient problem caused by particular diet, drugs, and habits (7–10). Also, a psychogenic disease termed pseudohalitosis or halitophobia also exists: patients affected by this disorder, despite having no objective evidence of oral malodor, strongly believe they have halitosis (4, 5, 11, 12).

In the last few years dentistry has seen a rising interest on halitosis due to increasing individual consideration and self-esteem of the patients. Special care dentists treating patients affected from disabilities, systemic

and psychiatric conditions may be more likely to manage patients with different causes of halitosis than any other dental specialty. The present report reviews halitosis and its implications in special care dentistry.

Origins and causes of bad breath in special care patients

The oral cavity is an important part of both digestive and respiratory systems, therefore the possible causes of halitosis are conditions where oral, upper and lower respiratory tract, digestive system, and diseases play a role on producing volatile compounds released in exhaled air with an unpleasant smell (7, 13–17). Special care patients (SCP) are prone to have halitosis, as the majority of them may have primary or secondary systemic conditions that might be the cause of oral malodor (Table 1). Diet, medications, some psychological and psychiatric as well as neurological disorders may also be the source of this problem in SCP.

Intra-oral causes

The most common source of halitosis is the oral cavity. A recent study conducted in Belgium on 2,000 patients found that an intra-oral cause accounted for

Table 1 Patients with special needs who may be at of risk of halitosis

Special Care category		
Physical impairment	<i>Cerebral palsy</i> <i>Stroke</i> <i>Traumatic injuries to CNS</i> <i>Arthritis</i> <i>Elderly people</i> <i>Amputated patients</i> <i>Multiple sclerosis</i> <i>Parkinson's disease</i> <i>Muscular dystrophy</i>	
Intellectual impairment	<i>Psychiatric disorders</i> <i>Anxiety disorders</i> <i>Dental phobia</i> <i>Down's syndrome</i> <i>Autism spectrum disorders</i> <i>Forms of dementia</i>	
Medically compromised patients	Respiratory diseases	<i>Foreign body (nose/lung)</i> <i>Sinusitis</i> <i>Tonsillitis</i> <i>Malignancy</i> <i>Bronchiectasis</i> <i>Tuberculosis</i> <i>Tonsilloliths</i> <i>Obstructions</i>
	Gastrointestinal and hepatic disease	<i>Helicobacter pylori infection</i> <i>GERD</i> <i>Hiatus hernia</i> <i>Zenker diverticulum</i> <i>Pharyngeal pouch</i> <i>Hepatic failure</i>
	Renal disease	<i>End stage renal failure</i>
	Metabolic diseases	<i>Trimethylaminuria</i> <i>Hypermethioninemia</i>
	Endocrine	<i>Poorly controlled diabetes</i>
Chemically dependent and drugs	Chemicals	<i>Tobacco</i> <i>Alcohol</i> <i>Betel</i> <i>Solvent abuse</i>
	Drugs	<i>Nitrites and nitrates</i> <i>Dimethyl sulphoxide</i> <i>Disulphiram</i> <i>Some cytotoxics</i> <i>Phenothiazines</i> <i>Amphetamines</i> <i>Suplatast tosilate</i> <i>Paraldehyde</i>
Long stay institutions	Prolonged hospitalization Institutionalized patients Homebound subjects	

the halitosis of 76% of the examined subjects (11). The oral surfaces are colonized by a large number of different species of bacteria which are able to produce malodorous substances (18, 19). Gram-negative anaerobic proteolytic bacteria are potent producers of

malodour compounds and comprise *Porphyromonas gingivalis*, *Porphyromonas endodontalis*, *Prevotella melaninogenica*, *Prevotella intermedia*, *Treponema denticola*, *Bacteroides loescheii*, *Eikenella corrodens*, *Bacteroides forsythus*, *Centipeda periodontii*,

Fusobacterium nucleatum, *Fusobacterium nucleatum polymorphum*, *Fusobacterium periodonticum* and *Veillonella alcalescens* (14, 20–24).

Major metabolic bacteria compounds that contribute to oral malodor are volatile sulfur compounds (VSCs) such as hydrogen sulfide (H₂S), methyl mercaptan (CH₃SH), and dimethyl sulfide (CH₃SCH₃) (18, 25, 26). Short chain fatty acids, such as propionic acid and butyric acid, cadaverin, indole, and skatole have also been reported to account for the source of the malodor (1, 27). The tongue and periodontal pockets are the main sites for production of VSCs dependent on a fast bacterial degradation activity of organic substrates from either endogenous or dietary origin (20, 21, 26, 28). Poor oral hygiene with accumulation of food debris and bacteria plaque on teeth and gingivae leads to gingivitis, necrotizing ulcerative gingivitis and periodontal disease (Xu et al., 2014), which reflect a pathological increase in the number of bacteria responsible for halitosis. Pericoronitis, peri-implantitis, prosthetic appliances, dry socket, oral mucosal infections, xerostomia, mouth ulcers and oral cancer may also cause malodor (7, 8, 16, 18, 29). Physically and intellectually impaired patients may have oral pathologies, often due to poor oral hygiene compliance or as result of the side effect of medications.

Sjögren's syndrome, diabetes (16), HIV, Crohn's disease, sarcoidosis, anemia, are examples of conditions that have oral manifestations which may lead to intra-oral halitosis in SCP.

Xerostomia is frequent among elderly patients, especially when homebound or institutionalized. This has been associated with the high number of their concomitant medications, where cardiovascular and psychiatric drugs are the most significant (30). During sleep, the proliferation of oral microorganisms associated with nocturnal hypo-salivation is responsible for the production of VSCs with resulting morning bad breath even in otherwise healthy subjects (28). However a study conducted in the Netherlands concluded that morning halitosis is only a transient phenomenon that often disappears in the late morning even without direct oral hygiene (31).

Extra-oral and systemic causes

Medically compromised patients are the largest category of patients treated in special care clinics. In these patients, frequent extra-oral causes of halitosis can be disorders of the upper, and to a lesser degree, lower respiratory tract. Acute and chronic infections of both the upper and the lower respiratory tract such as recurrent tonsillitis, sinusitis, bronchiectasis, have been reported as causes of malodor (2, 11, 32). Other airway conditions capable of generating bad breath may be pharyngeal ulceration, post-

tonsillectomy eschar, tuberculosis, ENT malignancies as well as foreign body in the nose or in the lungs (6, 8). Obstructions due to anatomical deformities or infections may create conditions for oral breath, leading to dry mouth as a potential cause of halitosis (33). Indeed patients with Down's syndrome may easily develop oral malodor, since they have a high incidence of respiratory infections and are susceptible to oral breathing (34). In contrast, no difference in VSCs level has been found between patients with repaired cleft palate and those without cleft, as long as the oral hygiene is controlled (35). Tonsilloliths, occurring as a result of chronic inflammation of the tonsils when debris calcifies in the crypts, have been proven to be a possible cause of unpleasant smell (36).

Although the gastrointestinal tract is not a common source of halitosis, a study carried out in Israel on 94 patients complaining of halitosis, found that 57% had upper gastrointestinal disorders and following the treatment halitosis improved in most of the patients (37). The production of VSCs has been strongly associated to *Helicobacter pylori* in patients with functional dyspepsia and its eradication can contribute to a rapid resolution of halitosis (17, 38, 39). *Helicobacter pylori* has also been detected in the saliva and periodontal pockets, identifying the oral cavity as a possible reservoir for such bacteria (40). Gastroesophageal reflux disease (GERD), the latter stage of Zenker diverticulum, and hiatus hernia have each been reported as a source of increased VSCs (41, 42). A significant association between GERD, BMI, and obesity has been found; for that reason bariatric patients may be at risk of extra-oral halitosis (30). At present, there is no reliable evidence to suggest that lower gastrointestinal tract disease gives rise to halitosis.

Liver diseases such as viral hepatitis, alcoholic hepatitis, and cirrhosis can be important causes of oral malodor. Dimethyl sulfide, acetone, 2-pentanone and 2-butanone have been identified in high levels in alveolar air patients with various degrees of hepatocellular failure and portosystemic shunting of blood, explaining sometimes the altered breath smell of individuals with liver conditions (*foetor hepaticus*) (43). Acetone is also responsible for the sweet "fruity" breath of patients with diabetes mellitus, and may be a strong indicator of high blood glucose in poorly controlled diabetes (16,44,45). Haemodialysis seems to help decreasing the uremic bad breath caused by high urea hydrogen levels in saliva of patients suffering from end stage renal disease (44,46). Trimethylaminuria is a rare metabolic disorder that leads to an increased level of trimethylamine in the patients sweat, urine, and breath giving off a characteristic tough fishy breath and body odor which

strongly distresses subjects (47). Hypermethioninemia is another rare genetic metabolic disease, caused by a deficiency in the enzymes that break down methionine, where the breath of the patient may have a strong smell resembling boiled cabbage (48).

Food and drugs

A large number of volatile food products and drugs can give rise to halitosis. Although some foods objectively give rise to an unpleasant breath odor, some individuals and several communities do not accept the term of halitosis when associated with certain foods such as garlic, onion, and spices since this is a normal part of their culture (8). The same consideration can be made for areca nut (betel nut) as chewed by more than 600 million people from Indian subcontinent, south Asia, and Melanesia. A study from India demonstrated that areca nut chewers are more prone to halitosis as well as periodontal conditions than non-chewers. The study did not explain whether the halitosis is caused by areca nut itself or it is a direct consequence of the poor periodontal status and oral ulcers induced by the use of this particular drupe (49).

There is weak evidence that chronic alcohol consumption is an independent cause of halitosis. The capacity of alcohol to generate oral malodor seems to be more related to a low saliva flow rate and periodontal disease than the volatile acetaldehyde excreted by the lungs (50).

Tobacco smoking as an independent factor of oral malodor is also controversial, and needs further investigations to determine whether the VSCs increase in the mouth of smokers (7).

A wide range of drugs can give rise to altered breath smell, including disulphiram, phenothiazines, paraldehyde, amphetamines, nitrites and nitrates, chloral hydrate, and some cytotoxic drugs are most acknowledged to be a direct cause of bad breath (8, 32).

Pseudohalitosis and halitophobia

Pseudohalitosis refers to patients who complain of having oral malodor (that objectively does not exist) which is often accompanied (or leads to) by significant avoidance of social situations. If after oral hygiene, reassurance, and psychological treatment the complaint continues, it is considered as halitophobia (5). An epidemiological study has shown that this phenomenon, previously considered very rare, may affect 16% of all patients attending halitosis clinics. The disorder seems to be more common in women than men (11). Frequently these patients are misdiagnosed by dentists and over treated for dental or periodontal problems. Moreover, often they receive unnecessary and expensive diagnostic and surgical procedures such as gastroscopies and tonsillectomies

resulting from incorrect diagnosis and referrals. Of relevance to this problem, a German survey revealed that 41% of dentists consider the stomach as a principal cause of oral malodour (51).

It has been suggested that patients with pseudohalitosis and halitophobia may fall within the spectrum of social anxiety disorder, whereas oral malodor may represent a symptom of psychiatric conditions such as olfactory reference syndrome (ORS), obsessive compulsive disorder (OCD), body dysmorphic disorder (BDD) (4, 5, 8, 12, 52).

Olfactory dysfunctions associated to neurodegenerative disorders may cause delusional halitosis, indeed parosmia and phantosmia episodes may occur in Parkinson's disease, Alzheimer's type dementia, and multiple sclerosis (53). Olfactory hallucinations are also common in schizophrenic patients, and may arise during epileptic or migranous aura (54).

Diagnosis of halitosis

The relationship between oral malodor, oral and extra-oral causes, lifestyle, habits are crucial (9, 15, 55). Therefore a detailed medical and social history as well as an extensive oral examination is essential during the diagnostic process (56, 57).

Although sometimes the diagnosis of halitosis may be made by other medical specialists such as ENT specialists or gastroenterologists, dentists are likely to be the most central clinicians diagnosing genuine or pseudo-halitosis (8, 19). Rosemberg, suggested setting up special dental appointments for the assessment, where the patient has to refrain from drinking, eating, chewing, gargling, and smoking for at least two hours before the appointment (56). The gold standard for objectively assessing the halitosis in dental practice is the organoleptic method. The test is based on the clinical judgement of the quality of the odor and can give useful information on the severity of the halitosis, and the health conditions of different areas of the oral cavity (35). This method, though, still has a certain degree of subjectivity. Therefore, trained clinical staff are recommended in order to improve the reliability and reproducibility of the test (58).

Patient self-assessment of bad breath is unreliable particularly when this is the primary patient complaint as cognitive, emotional, psychological and physiological factors may interfere with an objective judgement (4). For this reason, it is important that the patient attends the appointment with a relative or a confidant in order to attain a more realistic understanding of both extension and severity of the problem (56). Conversely, a recent Italian study reported that 94% of patients self-assessed for oral malodor correlated well with the organoleptic examination, particularly those with slight or moderate halitosis (59).

Commercial portable sulphur detectors are available

to estimate chairside the objective intra-oral VSCs level. Sulphide monitors (eg. Halimeter) and portable gas chromatograph (OralChroma) have a very high sensibility and sensitivity in determining the VSCs level in the exhaled breath. Nevertheless a recent paper reports that there is a good correlation between the organoleptic score and sulphur monitors and they can be used as an adjunct to the organoleptic score, which still has to be considered the gold standard for determining the presence of bad breath (58).

Other diagnostic methods are based on identifying the presence of bacteria producing VSC's using microbiological methods (dark field microscopy and bacteria culture), molecular biology methods (PCR and Real time PCR), and detection of trypsin-like activities of bacteria (BANA test) are not being used routinely in the clinical environment (8,32). Gas and liquid chromatography can be used to determine both intra oral and extra-oral volatile compounds otherwise not detectable by portable devices, but their use remains confined principally to research purposes (25, 27, 32).

Management

Extra-oral and systemic causes of halitosis should be managed by an appropriate specialist (eg. ENT, endocrinology, gastroenterology) for patient management and treatment (Table 2).

Intra-oral causes generally are plaque-related; as a consequence, adequate home oral hygiene regimen, periodical dental check ups, professional oral hygiene, and treatment of oral conditions generally improve or resolve the halitosis (8). Mechanical plaque removal by means of tooth brushing, interdental flossing, and possibly tongue scraping, is the most effective way to reduce the bacteria VSCs production (9,56,60). Chemical reduction of micro-organisms can be achieved using mouthrinses and toothpastes containing effective antimicrobial agents, such as chlorhexidine gluconate, triclosan, cetylpyridinium chloride, allylpyrocatechol, dehydroascorbic acid, L-trifluoromethionine (32, 57).

Amine fluoride/stannous fluoride and flavoring agents present in toothpastes may be helpful in easing morning bad breath via VSCs reduction (28, 61, 62). Temporary chemical neutralization of odorous compounds by means of mouthwashes and toothpastes containing zinc, sodium bicarbonate, magnesium, hydrogen peroxide, chlorine dioxide and iminium, has been demonstrated to be effective in lessening the offensive breath, although the efficacy appears to be limited to a few hours (57).

Avoidance of food products which cause altered breath smell lessens the halitosis related to dietary origin, and the same consideration applies to tobacco smoking and alcohol drinking. A recent American

Table 2 Treatment of halitosis for SCP

Prevention	<ul style="list-style-type: none"> - Regular dental check ups and clinical reviews - Homa oral hygiene <i>Tooth brushing</i> <i>Dental Flossing</i> <i>Tongue scrapping</i> - Oral hygiene instructions to caregivers 	
Treatment	Management of oral pathologies to reduce VSCs levels	
	Chemical reduction of VSCs	<ul style="list-style-type: none"> <i>Chlorexinine gluconate</i> <i>Triclosan</i> <i>Cetylpyridinium chloride</i> <i>Allyloyrocatechol</i> <i>Trifluoromethionine</i> <i>Dehydroascorbic acid</i> <i>Amine fluoride/stannous fluoride</i>
	Temporary odour neutralizers (limited a few hours)	<ul style="list-style-type: none"> <i>Zinc</i> <i>Sodium bicarbonate</i> <i>Magnesium</i> <i>Hydrogen peroxide</i> <i>Chlorine dioxide</i> <i>Iminium</i>
	Xerostomia management	<ul style="list-style-type: none"> <i>Saliva substitutes</i> <i>Citric acid</i> <i>Chewing gum sugar free</i>
	<ul style="list-style-type: none"> Avoidance of certain foodstuffs, alcohol, and tobacco smoking Halitophobia warrants referral to clinical psychologist Extra-oral causes of halitosis require referral to appropriate specialist 	

study found that mixing whole milk with garlic before the ingestion may help reduce the unpleasant breath smell after garlic intake (8, 63).

Masking products such as mints, sprays, and chewing gums without active ingredients have no significant effect on mouth malodor. On the other hand eucalyptus-extract chewing gum has been found to have long term effect on VSCs level as well as tongue-coating score compared to placebo (64).

Pseudohalitis can be treated by dental practitioners, but halitophobic patients must be referred to psychological specialists for evaluation and treatment of possible underlying mental health conditions. Unfortunately, only a very small number of these patients are willing to follow this advice, and there are no reports of the long term outcomes regarding these individuals (32, 65).

Recommendations for special care dentistry

Special Care Patients (SCP) who have intellectual or physical impairments are at risk of oral malodor, as they may not be aware of the necessity, or able, to accomplish an effective oral hygiene. Frequently caregivers may neglect the provision of normal oral hygiene for whom they are responsible as a result of poor dental knowledge or because of the disagreeable aspects of oral care (66). The same consideration applies to patients with chronic, physical and mental diseases, or frail elderly people, who may often be homebound or may need prolonged hospitalization. A recent survey carried out in Nigeria reported a poor level of oral health among psychiatric outpatients, agreeing with, and supporting, the results of a previous Italian study on institutionalized mental health patients (67, 68). Therefore instructions to caregivers must be given in order to assist SCP to achieve an acceptable oral hygiene.

Saliva substitutes or citric acid may help controlling the bad breath caused by xerostomia as a result of the side effect of several drugs, or when a symptom of a systemic or psychological disorder (18, 69, 70).

When the oral causes are excluded the halitosis may be a sign of an undiagnosed systemic, metabolic, or psychological disorder. Indeed, in the past, physicians used to test the patients breath for assistance in the clinical diagnosis of systemic diseases such as acute leukaemia (71). Thus, an accurate analysis of the medical and social history of the patient may be helpful to address appropriate referrals to different medical specialists for investigations and treatment.

Halitosis among SCP may be a cause of social isolation and psychological distress and it may strongly interfere in the quality of life of the patient (72). Improvement of the bad breath may not only

result in an improved physical and oral health, but it may be also achieve an improvement of psychological disturbance, the person being able to socialize with others, improving their quality of life.

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