ORIGINAL RESEARCH PAPER

Volume-7 | Issue-5 | May-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ADVANCED DIAGNOSTIC AIDS FOR ORAL MALODOUR DETECTION - A REVIEW

Periodontics

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ABSTRACT

The conventional diagnostic aids, organoleptic method is inevitable but its objectivity and reproducibility is not high. Other disadvantages extreme subjectivity of the test, the saturation of the nose and the reproducibility. The development of these small, easy to handle, chair side advanced diagnostic aids has overcome the disadvantage of the conventional diagnostic aids in great extent.

Additional or alternative chair side methods, such as breath checker, chemical sensor, tongue sulfide probe, diamond probe, halitox reagent kit and ammonia monitoring are infrequently employed.

KEYWORDS

INTRODUCTION

Oral Malodor, halitosis, fetor oris or bad breath are the general terms used to define unpleasant or offensive odour emanating from the breath regardless of whether the odour originates from oral or non oral sources.[1,2] It is an unpleasant universal medicosocial problem;[3] therefore it has always been a factor of concern for society experienced by most individuals result in transient discomfort.[4]

Most adults suffer from bad breath, occasionally an estimated 10-30% of USA population on a regular basis and this may lead to personal discomfort and social disagreement.[5] Furthermore, some authors estimate that approximately 50% of middle-aged and older individuals emit socially unacceptable breath.[6] The reported incidence ratio between female and male patients with oral malodour is almost the same.

In 85-90% of cases are intraoral origin can be attributed to deep carious lesions, periodontal disease, oral infections, peri-implant disease, pericoronitis, mucosal ulcerations, impacted food or debris, factors causing decreased salivary flow rate and, mainly, tongue coating[7] while 10-15% of cases are of an extraoral origin caused by certain respiratory and gastro-intestinal infections, systemic diseases, metabolic disorders or medications.[5,8,9]

Major compounds that contribute to oral malodor are volatile sulfur compounds (VSCs) such as hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH) and dimethyl sulfide (CH_3SCH_3).[2] Additionally, propionic acid and butyric acid, cadaverine, indole, and scatole, have been reported to cause oral malodor which results from the proteolytic degradation by predominantly anaerobic Gram negative microorganisms associated with gingivitis and/or periodontitis (*Porphyromonas gingivalis, Prevotella Intermedia/ nigrescens, Aggregatibacter actinomycetemcomitans, Camphylobacter rectus, Fusobacterium nucleatum, Peptostreptococcus micros, Tanerella forsythus, Eubacterium species, and spirochetes*) are known to produce large amounts of volatile sulfur compounds, which are malodorous.[2]

Before halitosis may be managed effectively, an accurate diagnosis must be achieved. An accurate diagnosis depends on analysis of data collected from patient history and physical examination. The patient history should contain chief complaint, medical, dental and halitosis history. Parts of the physical examination are extraoral examination, intraoral examination with special attention paid to the tongue and the periodontal tissues, and upper respiratory tract examination.

Most of the conventional diagnostic techniques like organoleptic method are simple and inevitable[10] but is scored on the basis of the examiner perception of a subjects oral malodor. This method lacks objectivity and reproducibility. There is also potential risk of disease transmission to the examiner through the expelled air. As such machine-based advanced diagnostic aids was developed which are highly objective, reproducible, and reliable. They are easy to be used chairside.

GAS CHROMATOGRAPHY

As an alternative to organoleptic testing, devices for measuring oral malodor have been developed. Gas chromatography (GC) with flame ionization detection has been applied to measure oral malodor.[11] A number of volatile components have been identified by GC.

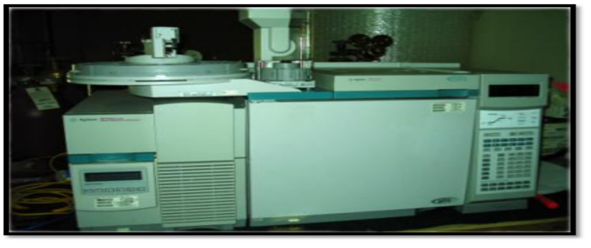

FIGURE-1: Gas chromatography

The gas chromatography (GC) equipped with a flame photometric detector (FPD) (GC-FPD) system being highly objective and reproducible is considered one of the most reliable measurements for diagnosing halitosis.

Gas Chromatography equipped with a indium oxide (In_2O_3) semiconductor gas sensor (SCS), which is highly sensitive to all kinds of VSC's has been developed recently. It measures each VSC's separately, whereas other devices cannot detect each separately.

Analysis of VSCs with gas chromatography may be useful for the primary diagnosis of a periodontal condition. Gas chromatography is therefore an alternative to the organoleptic test for halitosis detection.[12]

PORTABLE VOLATILE SULFUR MONITOR

Sulphide monitor[13] is a portable chair side equipment, that can assess oral malodor; these monitors are cost effective and commercially marketed as Halimeter® (Interscan, Chatsworth, California), Oral Chroma™ (Miyazaki)[14] and Breathtron® (Sopapornamorn),[15] which is equipped with an electrochemical sensor. Measurement is performed by inserting a disposable tube into the patient's mouth and connecting this to the monitor, while the patient is breathing through the nose. Electrochemical reactions with the sulphur-containing compounds in the breath generate an electric current, which is directly proportional to the levels of volatile sulphur-containing compounds.

HALIMETER

The Halimeter® device detects the presence of VSC's that are known to produce undesirable odours. Several readings are taken from areas such as the front of the mouth, the back of the mouth and the nostrils. The instrument measures parts per billion (ppb) levels of hydrogen sulfide and, to a lesser extent, methyl mercaptan. The monitors analyze the total sulphur content of the individuals' breath but cannot differentiate between various sulfides.

FIGURE-3: Halimeter

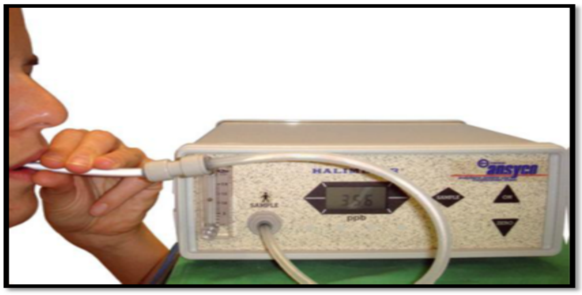

FIGURE-4: Portable sulphide monitor : HALIMETER® (Interscan Co.Chatsworth,CA)

·ORAL CHROMA

Oral Chroma™ (Abilit Corporation Kanagawa, Japan) analyses the VSC's, measures the individual concentrations of hydrogen sulfide, methyl mercaptan and dimethyl sulfide, and displays the concentrations on a display panel. Each of the three component gases, and the measured concentrations, can be correlated with a specific cause of halitosis.[14]

FIGURE-4: Oral chroma

The measurement of the VSC levels with the Halimeter or the Oral Chroma can be used as an adjunct to the organoleptic assessment. Considering the high specificity of the sulphur monitors, these devices can be used to prove the absence of malodour incase of pseudo-halitosis and halitophobia.

BREATHRON

Another sulfide monitor (Breathtron®, New Cosmos Electric, and Osaka, Japan) is also used among dental practitioners. It is a semiconductor type sulfide monitor, which is composed of an air intake, sensor detector, control panel, digital display and printer. The semiconductor sensor is based on a thick Zinc Oxide (ZnO) membrane that has a high specificity for VSC's.[15]

The disposable mouthpiece, which has a build-in filter to eliminate other volatile compounds (like ketone and alcohol in toothpaste and mouth wash), is inserted into an end of the Teflon tube connected to the monitor inlet. Measurements are performed by directly inserting the disposable mouthpiece into the patient's oral cavity. The patients are instructed to close their mouth tightly and breathe through their nose during the measurement. The aspiration rate of mouth air is 40–60 ml per minute, and the Breathtron® values are presented in units of parts per billion (ppb).[16] Because of this monitor's problem with differentiating sulfide compounds and because methyl mercaptan is three times more unpleasant than hydrogen sulfide at the same concentration, it is possible that Breathtron® underestimates the malodor in people with high methyl mercaptan concentrations in their mouths.[17]

FIGURE-5: Breathron

Recently, another sulfide monitor (BB Checker) has become available, but the overall sensitivity and specificity of this device do not exceed 50%.[18] Therefore, among the portable monitors, the Halimeter® and Breathtron® are the most appropriate devices for general dental practitioners because they are easy to handle and provide similar results to GC.

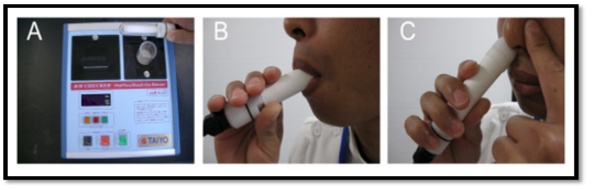

FIGURE-6: BB checker

BREATH CHECKER

·TANITA BREATH ALERT

It is an innovative palm size monitor that detects and measures the presence of VSC's and hydrocarbon gases in mouth air.

Detection of malodour in mouth air organoleptically and using a portable sulphide monitor and to correlate it with the clinical parameters, halitosis linked toxins and Benzoyl-DL-arginine-naphthylamide (BANA); using tongue and subgingival plaque samples.

FIGURE-7

(a) Tanita breath alert (b) Patient using breathchecker instrument.

Tanita's breathchecker as a motivational tool for encouraging the patients towards the better oral hygiene has been used, by co-relating the oral hygiene status of the patients with breathchecker scores and comparing the breathchecker scores before and after the complete oral prophylaxis, thus motivating the patient towards the better oral hygiene.[19]

·FITSCAN BREATH CHECKER

FITSCAN® Breath Checker [Figure 9], which is an innovative palm-size monitor that detects and measures the presence of breath odors (VSCs). It measures odor in seconds and results are displayed similar to organoleptic method.

FIGURE-8: Fitscan Breath Checker And Chemical Sensor

Chemical sensors for volatile sulphur containing compounds have been integrated into a probe for measuring directly in periodontal pockets and on the tongue. A sulphide-sensing element in the probe generates an electrochemical voltage proportional to the concentration of sulphide ions present.[20] This voltage is measured relative to the operating point of a reference element. The electrochemical voltages generated by sulphide ions are measured by an electronic unit and displayed in a digital score.

Latest developments lead to the so-called electronic or 'artificial noses', which are supposed to provide quantification and classification of exact smells.[21]

An artificial nose that has the same capacities as the human nose would be ideal.[22] Originally these devices have been developed for quantitative assessments of smells in food or beverages. However, an application to diagnosis of halitosis appears reasonable.

FIGURE-9: Electronic nose

FIGURE-10: Patient Using Chemical Sensor And Tongue Sulfide Probe

A new probe was developed that has simple and objective characteristics for sulfide measurement on the tongue dorsum. The sulfide level on the tongue dorsum (pS level) was determined using the tongue sulfide probe (Diamond General Development Corp., Ann Arbor, MI, USA).

Sensors for VSC's have been integrated into periodontal probes and paddles which can be placed directly into the pocket or on to the tongue, again yielding significant co-relation with organoleptic scores. The tongue sulfide probe size was developed to determine the sulfide levels on the tongue dorsum.

The localization of tongue odor was quantitatively assessed using this newly developed tongue probe in a chairside setting appears to be simple, reliable, and clinically user friendly tool.[23]

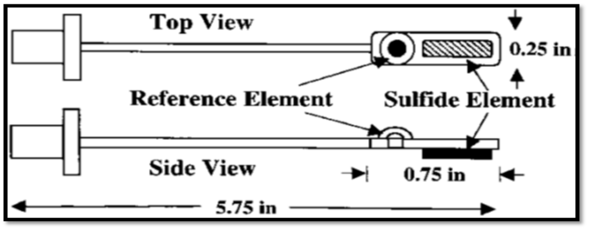

FIGURE-11:
Diagram of tongue sulfide probe. The sulfide-sensing element generates an electrochemical voltage proportional to the concentration of sulfide ions present. This voltage is measured relative to the operating point of the reference element.

DIAMOND PROBE/PERIO 2000

It is a dental device designed to detect sulphide concentration of various forms in gingival sulci. The system combines a conventional Michigan 'O' Probe style dental probe with a sulphide sensor, which measures probing depth, bleeding on probing and sulphide levels. The micro-sulphide sensor responds to sulphide ions and measures metabolic products of many anaerobic bacteria and, indirectly bacterial activity. The reaction of the sulphide ions with the sensor generates a measurable voltage that is proportional to the sulphide concentration. Therefore, the presence of high sulphide levels indicates a higher level of anaerobic bacterial activity.

The probe tip was gently inserted into the base of the gingival sulcus and moved along with light pressure. As the probe moved along the sulcus, the three parameters were recorded. If the presence of sulphide was indicated above threshold (>0.5), the light on the front of the display panel would change colours depending on sulphide concentrations and an audible tone would sound.[24]

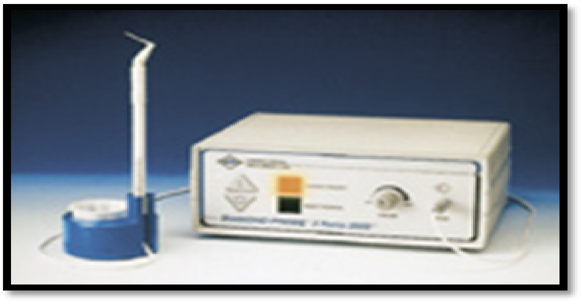

FIGURE-12: Diamond probe/Perio 2000

A chair side test kit (Halitox reagent kit) measures the halitosis linked toxins. It is quick, simple colorimetric test that detects both volatile sulphur compounds such as hydrogen sulphide and methyl mercaptan as well as polyamines like putrescine and cadaverine.

The colour chart contains 3 colour scale- low toxin, moderate toxin and high toxin.

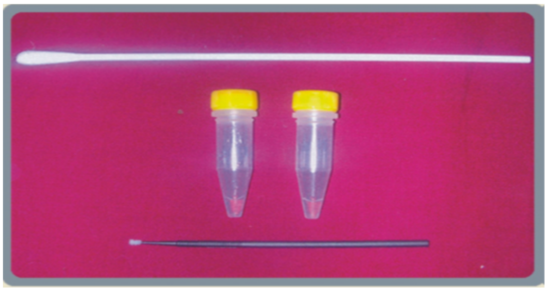

FIGURE-13: Halitox reagent Kit Ammonia Monitoring

Ammonia is another important factor in halitosis. Sulfur compounds can be detected by a portable sulfide monitor, but unfortunately ammonia cannot be measured using this method. Ammonia is the major basic gas in a variety of important sample matrixes, for example, the ambient atmosphere, indoor air, and human breath. Comparatively, breath contains high levels of ammonia; it is 1 ppmv in the breath of a healthy individual or may be higher in individuals with renal failure.[25,26]

CONCLUSION

The development of these small, easy to handle, chair side advanced diagnostic aids has overcome the disadvantage of the conventional diagnostic aids in great extent.

Additional or alternative chair side methods, such as breath checker, chemical sensor, tongue sulfide probe, diamond probe, halitox reagent kit and ammonia monitoring are infrequently employed.

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