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DENTAL SCIENCE
Review Article

How to Handle Halitosis Examinations?

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Received: July 13, 2015; **Published:** August 08, 2015

Abstract

Since bad breath, foetor ex ore or halitosis is a problem that affects nearly 25% of the human population, it is of utmost importance to identify, measure and quantify this disease, preferably in a standardised way. Direct test include "organoleptic" scoring by self-assessment or others-assessment and mechanical testing by halitometry or gas chromatography. Indirect test focus on the presence of specific microorganisms, their metabolic by-products or their related enzymes.

Organoleptic test, performed by trained odour judges, are subjective but still considered as the golden standard. Nevertheless, mechanical quantification is important for an effective confirmation of the problem and monitoring the phenomenon over time. Indirect test do not give any idea about the intensity of the odour and can only confirm the presence of certain bacterial species, mostly involved in bad breath.

There is no uniform protocol to detect, measure and quantify the odour yet. Complete different approaches are described in the literature. There is an acute need for a uniform clinical and scientifical approach in handling halitosis detection.

Keywords: *Breath; Halitosis; Oral hygiene; Gas chromatography; β-galactosidase*

Direct Examinations

Personal Examination

The presence or the level of halitosis can be estimated by asking the patients to assess their malodour. However, there is no statistically significant correlation between these subjective judgements and the different objective measurement methods [1]. This is due to the fact that someone who has halitosis may not be aware of the situation, or that people with halitosis become inured to their own bad breath over time [2]. Also, the correct diagnosis of the effective problem can be masked by psychopathological factors (such as obsession-compulsion, depression, anxiety, paranoid ideation or olfactory reference syndrome [3]), making the treatment more difficult.

Statistically significant correlations were found between the organoleptic diagnosis and volatile sulphur compound (VSC) levels determined by a halitometer.

On the other handsubjective patients' opinion correlates well with the objective evaluation of halitosis [4]. Significant associations between self-reported oral malodour, socio-demographic or medical history and oral hygiene variables were clearly found [5].

Self-judgement is the most descriptive question of the complete anamnesis and it is the most effective tool to determine the final result of a halitosis treatment, since other people rarely dare to give reaction to halitosis [6]. The judgement of another person is the second most important factor to bring the patient to a halitosis clinic.

Organoleptic Examination

The organoleptic judgement consists of sniffing at the patients' breath and scoring the level of the odour. Organoleptic judgements are still regarded as the golden standard for measuring halitosis and are significantly related to VSC values [7]. The organoleptic level of halitosis correlates with VSC and amines in the breath [8]. The organoleptic halitosis measurement is mandatory, whereas the instrumental detection method for VSC is not really necessary [9]. However, all these different tests are not standardized and investigators commonly use different techniques, not only for the preparation protocol, but also for the test protocols and the interpretation of the results.

Preparations

Patients should be instructed to refrain from drinking, eating, rinsing, gargling and smoking for at least 2h before the appointment to evaluate oral malodour [10]. Some ask not to brush, rinse or smoke immediately prior to the judgement, and not to eat and drink for at least 2h before the examination.-Patients should also not have taken antibiotics for at least 3 weeks [9]. There is no commonly accepted pre-measurement protocol in the literature available. To ask halitosis patients to fast 4h and refrain from oral hygiene is often a big challenge [11].

Tests

Many protocols exist. Evaluation of the breath while the patient counts loudly to 10, is one of the most valid options [6]. A tube can also be inserted into the patients' mouth while having the person exhale slowly [12].

Several modifications of organoleptic examination can be used:

1. Spoon test: sniffing a spoon that is used to scrape the tongue [10].
2. Floss test: the examiner passes floss through interdentally regions of posterior teeth. Odour is judged by holding the floss 5 cm from the nose [6].
3. Salivary odour test: the patient is instructed to spit saliva into a tube. The tube is covered immediately and incubated at 37°C for 5 minutes. The tube is held about 5 cm away from the nose for evaluation [13].
4. Wrist licking test: subjects lick their wrists, 5 seconds later, the odour judge sniffs from a distance of 5 cm and evaluates the odour [6].
5. Tongue coating test: Gauze is applied with pressure to the midline of the dorso-posterior part of the tongue and drawn anteriorly for about 2-3 cm. The gauze is removed and evaluated [14].
6. Prosthesis test: also a removable prosthesis odour can be scored [6].
7. Tonsil test: this is essentially a modified organoleptic examination, subjectively assessing odour of tonsil exudate or tonsilloliths [5].

Scaling

An examiner recognizes two parameters: quality and intensity. Odour quality can be judged as: nice, neutral, nasty, sulphurous, metallic, musty, etc. The severity of odour is classified into scales, such as a 0 to 5 point scale (0: no odour; 1: barely noticeable; 2: slight but clearly noticeable; 3: moderate; 4: strong and 5: extremely strong) [12].

Some use a 4-point scale, while some used a 5-point scale or even a 10-point scale. There is a complete lack in universality [7,12,15].

Judges

Some professionals are trained in odour ("odour judges"). It is argued that they have capability to detect, quantify, identify and diagnose halitosis gases emitted from the patients' breath or mouth by using their nose. The human brain saves nearly 7500 odour records during life, which are afterwards used to compare newly smelled odour [16]. Highly experienced odour judges are expected to recognise special odour types in their memory [17].

Odorants can cause desensitization if smelled for prolonged periods due to saturation of the perception in the nose [18]. Other factors, such as age, gender, time of day, subjectivity etc., do influence the credibility of organoleptic measurements. Therefore they are not reproducible and are extremely subjective, emotional, instinctive, learnable, intuitive and also indexed to the socio-economic background or experiences of the examiner [7].

Examiners find it often repulsive to smell on halitosis patients' breath. To decrease unpleasant situations, the patient can be asked to breathe inside a plastic bag for a while. Afterwards the judge sniffs at the odour from the bag [19]. Sometimes a privacy screen is used to hide the direct-sniffing contact from the patients who assume that they have undergone a specific malodour examination instead [12]. Also negative pressure syringe method (sample bags) is an option to obtain a higher degree of privacy for the patient or more accurate results [20].

Halitometric Examination

Gas chromatography (GC) combined or not with mass spectrometry (MS), is highly sensitive for VSC detection. Nevertheless, routine application of these tests is impractical given the costs, the complexity and the required staff expertise [21].

The GC-based OralChroma™, (Abimedical, Japan) is a portable equipment, capable to determine the amounts of hydrogen sulphide (H_2S), methylmercaptan (CH_3SH) a dimethyl sulphide ($(CH_3)_2SH$)

Other available halitometers are: (1) the Halimeter™ (Interscan Corporation, USA); it contains an electrochemical sensor for detecting the total amount of the VSCs (H_2S + CH_3SH + $(CH_3)_2SH$); (2) the semiconductor gas sensors Breathtron™ (New Cosmos Electric, Japan) constructed as a zinc oxide film with specificity for hydrogen sulphide and mercaptans; and (3) the Twin Breasor™ (GC, Japan); the Diamond Probe/Perio 2000™ (Diamond General Development, USA) [22]. They are all portable devices for detecting several gases including VSC and other odorous gases in mouth or breathe air [23].

Alcohol, chlorine and etheric volatiles, found in the breath, can have an influence on sulphide sensors [24]. The Halimeter™ confuses VSCs with other odorants, and may not be selective enough for halitosis. It reads inexistent VSCs when it is exposed to juices, jasmine flower, buttermilk or even soap [11]. The OralChroma™ reads more comprehensive VSCs level than the Halimeter™, but it cannot fully determine the actual level of halitosis due to potential contributions from non-VSC gases [25].

Sensor systems (electronic noses or e-noses) consist of chemical sensor arrays for the detection of not just one group of volatile components but different volatile compound profiles (halitoprints), and use an algorithm for pattern recognition [26]. The disadvantage is that they detect some volatiles that are not detectable by the human nose.

Indirect Examinations

Chemical examinations

Beta-Galactosidase Test

β-galactosidase is an enzyme that catalyses the hydrolysis of lactose. It is only synthesized by lactose-positive bacterial species. β-galactosidase activity of saliva taken from patients with halitosis, is measured by using these chromogenic substrates, which have been correlated with malodour strength (organoleptic score, sulphide monitor score and VSC concentrations) [27]. β-galactosidase activity of oral microbiota has been even associated with physiologic halitosis, which is not necessarily associated with oral problems or with periodontopathic bacteria [28,29].

Indole test

Indole, ammonia and pyruvate are the result of the deamination process of tryptophan by tryptophanase. Each of these components has a bad odour. Indole has low volatility, low perception threshold and it remains resolved in saliva as an intercellular signal molecule that mediates biofilm formation between microbial cells [30]. It was examined in the mouth as a criterion of halitosis, but no clear correlation was found between odour concentrations and the indole or skatole amounts [31].

Ninhydrin test

Low-molecular weight amines and amino acids levels may give information on halitosis caused from bacterial putrefaction. The ninhydrin method is simple, rapid and inexpensive. This method is a kind of colorimetric reactions [32]. α- amino acids typically give a blue-purple product, whereas proline (a secondary amine) gives a yellow-orange product.

Lead acetate test

Lead (Pb) is used to calorimetrically detect sulphur in a medium, due to the fact that Pb turns into PbS. This is evaluated as a black coloured visualization. The saliva taken from a patient is incubated for half an hour and its colour is checked. Black colour shows the sulphur content of the saliva [14]. If it would be possible to develop a test method for instantly checking and quantifying the sulphur content in saliva, then this test would be predictive to estimate the VSC content.

Benzoyl-DL-arginine-NaphtylAmide (BANA) test

The enzyme capable of hydrolysing benzoyl-DL-arginine-naphthylamide (BANA) is present on commercially available test strips. If bacteria, having this hydrolase, are present in the medium, they will hydrolyse BANA, which will result in a blue colour, indicating a positive test result. BANA is found accurate to identify especially 3 bacterial species: *Porphyromonas gingivalis, Treponema denticola* and *Tanerella forsythia* [33-35]. If those 3 bacteria (or 1 or 2 of them, or another BANA-positive bacterium) are present, the test strip turns blue. The bluer it turns, the higher the concentration and the greater the number of organisms. Specificity and sensitivity of the BANA test are above 80% and the predictability for periodontal disease in untreated patients is above 83% [20].

Conclusions

Self-judgement and other people's judgement are the unique reasons for a patient to seek for a consult concerning halitosis. The initial contact with a patient commonly originates from a complaint of halitosis, identified by another person from the patient's social environment, or suspected by the patient self. All organoleptic methods, including directly sniffing of oral air or indirectly sniffing a sample, are subjective and not reproducible. Chemical and enzymatic methods briefly estimate the presence of bacteria or their enzymes but do not prove halitosis. Halitometric assessment, especially multi-gas detecting systems is very objective, reproducible and can detect odorous gases in a wide spectrum. However, if the patient or his social environment does not complain about halitosis, then halitometeric readings are of no sense since there seems to be no problem. Therefore, halitometer can only be used for confirmation of halitosis, comparing similar cases, and monitoring the therapy, but not for a diagnostic purpose alone.

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Volume 2 Issue 2 August 2015