Breath odour is the presence of odorous volatile organic compounds in the breath of individuals. It is a widespread problem, as it affects a high percentage of the adult population; 70% of the global population suffers from chronic oral malodour and 74% per cent considers it an issue. Breath odour has strong social implications for the sufferer and it significantly affects normal social interactions.

Breath odour can have physiological or pathological causes of intra- or extra-oral origin (Fig. 1). Physiological odour includes morning breath, which is transient and related to low salivary flow during the night. Other lifestyle factors can influence its occurrence, such as smoking, as well as the consumption of alcohol or odouriferous foods and drinks (garlic, onion and cabbage, among others). These are fairly common reasons for concern in the adult population; but can easily be rectified by modification of beverages and foods consumed, toothbrushing, mouthrinses and tongue cleaning.

Pathological malodour, however, is more challenging to treat. Extra-oral breath odour can arise from respiratory, gastrointestinal or metabolic issues, which cannot be addressed by oral hygiene, as these do not originate from the mouth. Most cases, however, originate from the oral cavity. Breath odour from intra-oral causes arises from volatile sulphur and organic compounds (VSCs and VOCs, respectively) formed as a result of the degradation of organic substrates by anaerobic bacteria on the dorsum of the tongue, particularly at the back of it. It can also result from gingivitis and periodontitis, and their combination with tongue bacteria. However, in individuals with good oral hygiene and general health, the main cause is the bacteria on the tongue (Fig. 2a). Breath odour is generally assessed by organoleptic score, which is determined by a trained odour judge, who measures the strength of target odours and expresses the value according to a predefined scale from 0 (no odour) to 5 (strong malodour).

A niche for bacterial biofilms

The tongue has a very complex and rough surface structure covered with flexible papillae (Fig. 2b). These papillae vary in shape, size and distribution pattern and give the tongue a surface with numerous crypts and fissures. This constitutes a perfect microbial niche for anaerobic bacteria to thrive and form, which allows biofilms to thrive on the tongue. Bacteria can degrade a complex mixture of amino acids and proteins from numerous origins (diet, debris, cells) with their complex enzymatic machinery. Particularly the degradation of amino acids, such as cysteine and methionine, produces VSCs with a very high odour power. The bacterial density on the tongue surface has been related to the degree of breath odour. For example, individuals with noticeable breath odour (above 2.5 in the 5-point organoleptic scale) have more than 1 × 108 bacterial colony-forming units per cm² of the tongue, while individuals with lower organoleptic scores harbour lower bacterial numbers (approximately 1 × 10⁷). Therefore, in order to reduce breath odour in patients, the tongue bacterial density must be reduced and kept at low levels.

Treatment of oral malodour

There are numerous over-the-counter products for oral malodour and these can be divided into chemical and mechanical treatments. Chemical treatments are mostly mouthrinses specifically developed for oral malodour, containing a combination of antimicrobials and metal ions. Commonly used antimicrobials are chlorhexidine and cetylpyridinium chloride (CPC), which have a strong effect in killing bacteria. Metal ions, such as zinc, bind to sulphur compounds and form insoluble complexes (zinc sulphide) that are not volatile and are therefore non-odoriferous. Another category of mouthrinses for malodour contains chlorine dioxide, which neutralises the sulphur gases and oxidises VSC, while the chlorite ions act as an anti-bacterial compound.

While mouthrinses have the potential to be very effective owing to their antibacterial and oral malodour masking properties, they rarely provide a long-lasting result. They are effective for a few hours, but they have little effect on the tongue bacterial density. A possible cause of this limited effect on the tongue is that the active components of mouthrinses cannot reach the tongue-producing bacteria. Biofilms that produce volatile gases are mostly located deep between the tongue papillae (Fig. 2c), where mixing and diffusion of active ingredients are difficult owing to the small papillary spaces, the viscosity of salivary molecules and the low permeability of biofilms. Guidelines for the treatment of oral malodour by dental professionals emphasise the need for tongue cleaning using scrapers or brushes.

Clinical studies have shown that the use of mechanical methods reduces the tongue coating. However, the effect on malodour is very short lived, which is probably due to the reduction of the bacterial nutrients present in the tongue coating rather than the reduction of the bacterial density itself. The limited amount of bacterial removal from the tongue’s complex surface is due to the difficulty in reaching the biofilm between the tongue papillae. Moreover, as the tongue tissue is very flexible, the use of tongue scrapers could flatten the papillae, trapping the bacterial biofilm underneath and not removing it.

Combined approach for all-day fresh breath

The use of mouthrinses in combination with mechanical intervention could help the active ingredients penetrate deeper into the biofilm than when used alone, while simultaneously reducing the tongue coating and bacterial density. The combined approach of chemical and mechanical intervention could have a synergistic effect on oral malodour to deliver full-day
fresh breath, as has been shown in recent studies.23,20 In a recent clinical investigation, we showed that the combined use of a newly designed sonic tongue brush with an antimicrobial spray delivered a significantly superior reduction in breath odour than did the individual treatments.

Philips Oral Healthcare has recently developed and launched a new sonic powered tongue brush and antibacterial spray combination, Sonicare TongueCare+. The brush has been designed to penetrate between the tongue papillae and to provide thorough mechanical biofilm removal. Bristle dimensions and stiffness parameters were optimised based on analysis of the human tongue. The brush head consists of 240 flexible elastomer MicroBristles mounted on to a Sonicare power toothbrush handle, with 31,000 vibrations per minute to help break up any tongue coating and sweep away debris and bacteria (Fig. 3).

TongueCare+ brush is used in combination with the BreathRx antimicrobial tongue spray (Philips), which contains antimicrobial agents, such as CPC and zinc. In the first proof of principle clinical investigation of this technology, it was shown that the organoleptic score and the tongue bacterial density can be significantly reduced with a single use of TongueCare+ with BreathRx, measured up to 6 hours (Figs. 4a & b). This combined treatment reduces breath odour significantly more than using TongueCare+ alone or BreathRx alone, supporting the idea that a combined approach is likely more effective.

Moreover, TongueCare+ has been shown to significantly decrease the tongue bacterial density, which is kept low for up to at least 6 hours, indicating that the root cause of breath odour is addressed with this approach. This, combined with the high level of organoleptic score, provides a more effective and long-lasting treatment option for people suffering from breath odour.

Possible oral health implications

Overall, it is of key importance to integrate tongue cleaning into the oral hygiene routine in order to have fresh breath all day. Additionally, it has been suggested that the tongue can act as a reservoir of periodontal pathogens for the rest of the mouth,24,25 which could colonise other areas and have an impact on oral health in general. Moreover, several studies have shown that VSCs, such as hydrogen sulphide and methanethiol, are toxic to periodontal tissue even when present in very low concentrations, so it has been hypothesised that they can contribute to the progression of gingival diseases.26 Therefore, maintaining a good tongue cleaning routine could have far-reaching implications.

Editorial note: A list of references is available from the publisher.

Conflict of interest: Dr Paola Gomez-Pereira is a senior scientist at Philips in Cambridge in the UK.

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The iTOP experience
Providing thorough oral hygiene instructions in a clinical setting

By Theodora Little, UK

"iTOP" stands for "individually trained oral prophylaxis." You may argue that hygienists deliver this to their patients all the time, right? Unfortunately, with the time constraints placed upon hygienists in the UK, with 30- or 20-minute appointments and many without a nurse, the burning question is, how are we supposed to give patients the essential care, as well as effectively provide thorough oral hygiene instructions?

We mention time and time again that we strive for prevention and that this is key, but unfortunately all there is time for is a scale and polish with a little oral hygiene instruction. We are thus placed in a vicious cycle of patients returning for each appointment with the same oral hygiene as before. Habits remain unchanged.

At Curaden Dental Clinic, my hygiene appointments last a minimum of one hour. Curaden is a Swiss company, so this is something of the norm for it. The company takes great pride in offering high-quality products and services to patients, which is also why we recommend CURAPROX products. It is not just about their vibrant colours, which initially attract attention, naturally, there is more to the products than meets the eye. CURAPROX uses CUREN filaments instead of nylon, and their manual toothbrush contains 5,460 filaments—approximately 4,500 more than the average manual toothbrush. All of this is included in iTOP, since they only use the best in their training for dental professionals.

I suppose many will say I am lucky to be able to offer hour appointments, but as a practice we want the best for our patients. Our practice focus is prevention, and it is necessary to give time to our patients to achieve this. On occasion, the whole hour is used for iTOP training only, with my training to be a hygienist and therapist, the most basic training given would include correct and efficient brushing of teeth. I am somewhat ashamed to say that not once during my time at university did we have intra-oral demonstrations with a manual, electric, sonic or any other toothbrush. Certainly, we had a lecture and will hopefully attend the teachers' seminar later this year. Going through this programme, I started to realise that correct, effective and thorough toothbrushing is somewhat of an art, and it should not be dismissed so easily. It is also something that should not be rushed; great care and time do need to be taken to change a patient's habits. Of course, many may argue that patients will not want to spend x amount to receive oral hygiene instructions and that one cannot teach an old dog new tricks.

I agree to an extent, however, once one has gained a patient's trust and he or she understands the value of this service, the patient will be more than happy to accept. We all understand how important it is to communicate well with our patients, and this combined with sufficient working time, allowing for iTOP is one of the greatest factors. Not only are my patients satisfied, happy and grateful, they are also shocked that they have never had training on how to brush properly. As a hygienist and therapist, I too gain enormous job satisfaction and can honestly say I love what I do.

Going through this programme, I started to realise that correct, effective and thorough toothbrushing is somewhat of an art…

main emphasis on educating the patient, starting with the basics. I will discuss products in depth with the patient, giving him or her the full knowledge to understand the benefits of these. I will also brush for the patient, not just a few teeth but all four quadrants, so he or she can feel exactly how it is supposed to feel in each area. I will of course then ask the patient to demonstrate toothbrushing to me afterwards. Usually, I will brush my teeth at the same time, as we can also learn from watching others carrying out the same task (and the patient will feel less self-conscious).

With floss and interdental brushes, do the same and will fill out the full-mouth chart for the patient to take home if more than one size interdental brush is required. Moreover, I will discuss toothpastes and mouthwashes, explaining the advantages and disadvantages, and how to gain the most benefit from them.

You may question why you need iTOP training, since surely you learnt all of these skills at university? You would think that in time, as we can also learn from watching others carrying out the same task (and the patient will feel less self-conscious).