

## Review Article

# Effects of orthodontic therapy on halitosis

### ABSTRACT

Halitosis denotes the offensive odor of breath. The condition frequently causes embarrassment, may affect interpersonal social communication, and has also become an important market for pharmacological and cosmetic industries. A recent study reveals a prevalence rate of 21.7%–35.3% for halitosis among Indian dental students. The effect of orthodontic treatment, be it fixed or removable appliance therapy on the rate of halitosis is substantial. This article is an attempt to throw light on the various determinants of halitosis during orthodontic therapy and also presents few tips for better breath during the same.

**Keywords:** Halitosis, oral malodor, pseudohalitosis, rapid maxillary expansion, self-ligating brackets

### INTRODUCTION

Halitosis is a lyrical term derived from the Latin word “*halitus*” (breath) and the Greek suffix “*osis*” (condition and action of a pathologic process).<sup>[1]</sup> Halitosis denotes the offensive smell of breath. Synonyms for bad breath are fetor ex ore, oral malodor, or offensive breath. Humans emit a variety of volatile and nonvolatile molecules that are influenced by genetics, diet, stress, and disease. The condition frequently causes embarrassment, may affect interpersonal social communication, and has also become an important market for the pharmacological and cosmetic industries (with millions of dollars spent annually on medications and over-the-counter products). Oral malodor may rank behind only dental caries and periodontal disease as the reason for patients visiting the dentist, the perception of halitosis being different in culturally diverse populations.<sup>[2]</sup>

### PREVALENCE

There are few studies<sup>[3-6]</sup> documenting the prevalence of halitosis in population-wide or community-based samples. In the general population, halitosis has a prevalence ranging from 50% in the USA to between 6% and 23% in China, and a recent study had revealed a prevalence of self-reported

halitosis among the Indian dental students ranging from 21.7% in males to 35.3% in females. Miyazaki concluded that there was increased correlation between old age and malodor with aging, resulting in greater intensity of the odor. In above 60 years age group of the Turkish individuals, the incidence was around 28%. A thorough literature search reveals that there is a lack of conclusive evidence on the prevalence of halitosis in India, especially among the general population.<sup>[7]</sup>

### CLASSIFICATION OF HALITOSIS

Halitosis can be broadly classified on the basis of its origin as genuine halitosis and delusional halitosis.

Genuine halitosis can be broadly classified as follows:

1. Physiological (foul morning breath and morning halitosis) is caused by stagnation of saliva and putrefaction of entrapped food particles and desquamated epithelial cells by the accumulation of bacteria on the dorsum of

**NITHIN VARGHESE JOY, PRATHAM PAI,  
H. JYOTHIKIRAN, N. RAGHUNATH**

Department of Orthodontics, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysore, Karnataka, India

**Address for correspondence:** Dr. Nithin Varghese Joy, Department of Orthodontics, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysore, Karnataka, India.  
E-mail: [nithinvj007@gmail.com](mailto:nithinvj007@gmail.com)

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the tongue, recognized clinically as a coated tongue and decrease in frequent liquid intake

2. Pathological can be further subdivided into intraoral and extraoral causes: delusional halitosis (monosymptomatic hypochondriasis/imaginary halitosis) is a condition in which a participant believes that their breath odor is offensive and is a cause of social nuisance; however, neither any clinician nor any other confidant can approve of its existence. Delusional halitosis can be further divided as follows:
  1. Halitophobia – halitophobia is fear of having bad breath seen in at least 0.5%–1% of the adult population. Such patients do not get convinced that they do not suffer from the problem and need psychological counseling
  2. Pseudohalitosis – pseudohalitosis patients complain of having oral malodor without actually suffering from the problem and eventually gets convinced of a disease-free state during the diagnosis and therapy.<sup>[7]</sup>

Various studies show that 85%–90% of all cases exhibit bacterial decomposition of organic material in the oral cavity as a cause for halitosis. The metabolism of Gram-negative bacteria which survives mainly on protein-containing sulfurous amino acids (methionine, cysteine, and cystine) produces volatile sulfur compounds (VSCs), which take a central role in the development of halitosis. Sixty percent of all oral microorganisms are situated on the tongue, which represents the primary source of bacteria in the oral cavity and the main cause of halitosis. Quantitative measurements confirmed the prominent significance of the microflora of the tongue for the etiology of halitosis. Extraoral causes are uncommon and include otorhinolaryngological changes (specifically colds), general systemic conditions, use of medication, consumption of tobacco, particular dietary habits, as well as smells originating in the gastrointestinal tract. Factors favoring halitosis are tongue coating, periodontal diseases, large cavities with open root canals, pericoronitis, conditions affecting the oral mucous membrane, food impaction, neglected dentures, reduced salivation, and oral breathing.<sup>[8]</sup>

Various studies have investigated the influence of orthodontic appliances on the level of bacteria in the oral cavity. The side effects of fixed orthodontic mechanotherapy include decalcification, white spots, cavities, periodontal reactions, and gingivitis.<sup>[9-12]</sup> Fixed orthodontic appliances favor the accumulation of plaque, therefore increasing the risk of whitespot lesions during treatment. The design and surface structure of the orthodontic appliance, as well as the composite, influence plaque retention. The manner of mounting the orthodontic wire on the brackets also plays a role.<sup>[8]</sup>

The three primary measurement methods of genuine halitosis are organoleptic measurement, gas chromatography, and sulfide monitoring. Additional or alternative measurement methods are the N-benzoyl-DL-arginine-2-naphthylamine (BANA) test, chemical sensors, salivary incubation test, quantifying -galactosidase activity, ammonia monitoring, ninhydrin method, and polymerase chain reaction.

## ORTHODONTIC TREATMENT AND HALITOSIS

Orthodontics and periodontics have a complex relationship within the mouth. Proper alignment of the dentition facilitates good oral hygiene, although the process of straightening teeth through orthodontic therapy may have negative effects on the periodontium through direct gingival irritation and compromised oral hygiene effectiveness. Appliances encourage plaque accumulation and the development of gingivitis. Bands, brackets, and orthodontic wires present unique challenges for hygiene as these appliances create many food and plaque traps. Interproximal care is much more difficult requiring floss to be threaded beneath the wire for each tooth. This becomes a time-consuming process that requires skill and dexterity to complete. Additional accessories such as coil spring tubes, steel lacing, and elastomeric chain can provide additional hygiene difficulties.

Thus, the presence of orthodontic appliances increases plaque retention, which reduces the effectiveness of daily oral hygiene. Most studies<sup>[13,14]</sup> report increased plaque index scores within 1–3 months after appliance placement. As plaque communities persist, a shift from aerobic to anaerobic bacteria occurs. This shift in the bacterial profile is consistent with one associated with periodontal health to one typically associated with active periodontitis.<sup>[15]</sup>

The effects of orthodontic treatment on periodontal health have been investigated in several studies. Many researchers have observed the inflammation of gingival tissues during fixed orthodontic therapy. This condition has been related to oral hygiene measures hampered by fixed orthodontic appliances with consequent increases in the accumulation of bacterial plaque. Brackets, archwires, and other appliance components are both a focus for plaque accumulation and obstructions to plaque removal, thereby promoting gingivitis. Plaque also harbors cariogenic bacteria potentially capable of hard-tissue damage, especially at the bracket margins. Accordingly, once the fixed appliances are removed after the treatment, the inflammation can be expected to resolve. Patients who undergo orthodontic treatment with fixed appliances often have problems cleaning the tooth surfaces effectively around the attachments. Protected plaque in

interproximal sites produced substantial odors and is associated with overall levels of VSCs.

The presence of dental plaque leading to deteriorated gingival and periodontal health could contribute to oral malodor. Due to the long treatment time in orthodontic practice, a rigid plaque control program is indispensable. Professional tooth cleaning at short intervals must be complemented by efficient oral hygiene procedures at home.<sup>[1]</sup>

### COMPARISON BETWEEN SELF-LIGATING BRACKET VERSUS CONVENTIONAL BRACKET

Parallel to metallurgic improvements in orthodontics, manufacturers presented self-ligating brackets (SLBs) to overcome the side effects of conventional brackets (CBs). In addition to the reduced chair time and biomechanical advantages of SLBs, the possibility of better oral hygiene owing to reduced complexity and fewer retentive sites for microbial colonization is a favorable aspect of SLBs. In a study conducted by Nalçacı *et al.*,<sup>[16]</sup> the SLBs group showed lower and more stable halitosis parameters after bonding. The study revealed that the SLBs group showed better values for the periodontal parameters, probably corresponding with the SLB type used. Pellegrini *et al.*<sup>[17]</sup> suggested a higher retention of plaque accumulation on CBs ligated with elastomeric ligature than on SLBs. Mummolo *et al.*<sup>[18]</sup> stated that the CBs showed statistically significantly higher lactobacilli colonization when compared to that of participants treated with SLBs. Pithon *et al.*<sup>[19]</sup> reported greater bacterial accretion on the SLBs than on the CBs ligated with elastic ligature. Pandis *et al.*<sup>[20]</sup> stated that although the SLBs eliminate the need for elastics, the mechanisms of these brackets may provide additional plaque-retention spaces. In addition, the researchers have suggested that the components of SLBs are not subjected to regular renewal such as in elastomeric modules. Thus, a theoretical advantage may be eliminated in reality, where calcification of the plaque leads to obstacles in the functioning of the opening–closing mechanism.<sup>[16]</sup>

### EFFECT OF REMOVABLE ORTHODONTIC APPLIANCES ON HALITOSIS

In the mid-1980s, it was confirmed that removable orthodontic appliances (ROAs) have unfavorable effects on the oral prevalence and density of *Candida*, as well as on salivary pH and plaque formation, – although these effects are limited to the duration of treatment. The greatest density of microorganisms is found on the appliance itself, followed by the covered area of the palate. It is essential that ROAs be properly cleaned if good oral hygiene is to be maintained. First, this can reduce the risk of caries, *Candida*-associated

stomatitis, and halitosis. Second, it may prevent infection or reinfection from the ROA, particularly in patients with an impaired immune system. Cleaning ROAs can be a difficult task with the presence of clasps, expansion screws, marginal crevices and surface indentations demanding extra attention for thorough cleansing. The roughness of the acrylic surface greatly encourages plaque accumulation; depressions of >0.2  $\mu\text{m}$  favor microbial adhesion. Moreover, the microporosity of the material acts as a microbial reservoir so that the microorganisms may even infiltrate the acrylic base.<sup>[21]</sup>

Studies have shown that the use of ROAs, particularly invisible aligners, allows adequate oral hygiene and can reduce the risk of dental and periodontal complications such as white spot lesions, caries, and periodontitis when compared with fixed orthodontic therapy. About the correlation between halitosis and orthodontic aligners treatment, it has been shown that aligner treatment is characterized by only minimal impairment of overall oral health and the associated quality of life. Neither halitosis, nor oral dryness, nor high plaque or gingival index (GI) measurements were observed. Aligner appliance can be removed, and oral hygiene can be maintained as any other person not undergoing orthodontic therapy.<sup>[22]</sup>

### EFFECTS OF RAPID MAXILLARY EXPANSION ON HALITOSIS

Transverse maxillary deficiency, accompanied by a high palatal vault, is a symptom of a skeletally developed syndrome that causes some rhinologic disorders and has certain undesirable effects on the dentofacial pattern. Some features of this problem are a decrease in nasal permeability resulting from nasal stenosis, elevation of the nasal floor, bilateral dental maxillary crossbite, mouth breathing, and because of enlargement of the nasal turbinates, a decrease in nasal airway size.

Treatment for transverse maxillary constriction involves the use of rapid maxillary expansion (RME). It promotes the separation of the maxillary bones in a pyramidal shape in which maximum expansion is near the incisors, just below the nasal valves. This treatment expands the external walls of the nasal cavity to increase its capacity. This can result in improvement of the patient's ability to breathe through the nose.

Considering the above information, a recent study was conducted with the idea that changes in the nasal cavity obtained by RME treatment in patients with maxillary constriction might facilitate nasal breathing and decrease oral malodor. RME separates the walls of the nasal cavity laterally. This situation increases intranasal capacity and improves the breathing pattern facilitating nasal breathing and reduced periodontal inflammation caused by oral breathing, leading to a decrease in the GI ultimately leading to decreased halitosis.

Another mechanism by which RME could lead to decreased halitosis is by changing the breathing pattern from oral to nasal; it consequently causes an increase in the quantity and flow rate of saliva, thereby increasing the “washing off” effect of saliva and decreasing the production of malodor-producing Gram-negative anaerobic bacteria.<sup>[23]</sup>

### TIPS FOR BETTER BREATH WITH ORTHODONTIC APPLIANCES

1. Brushing at least 2–3 times/day, especially much attention to be given to clean the dorsum of the tongue, gingiva, and the palatal mucosa
2. Use of additional oral hygiene aids such as dental floss and interdental brushes to make sure that minimum food debris is left to stay. Care to be taken while working around the brackets
3. Use of antibacterial mouthwashes not only gets into the spaces between the teeth (especially after flossing) but also helps to kill bad breath-producing microorganisms in the mouth
4. Regular and frequent thorough cleaning of ROAs are also highly recommended as these are some of the major sites for bacterial colonization
5. Additional aids such as water picks and breath mints can be added to the armamentarium in the fight against oral halitosis during orthodontic treatment.

### CONCLUSION

It has been a proven fact that orthodontic therapy increases the likelihood of periodontal breakdown in patients of all ages unless a meticulous oral hygiene regimen is advocated by the clinician as well as practiced by the patient throughout appliance therapy. Be it fixed/ROAs, exercising good plaque control is very critical. An interesting finding was the effect of RME on halitosis even though more research to confirm the negative correlation between them need to be carried out.

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### Conflicts of interest

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