jcda.ca

Taste Disorders: A Review

Nan Su, BSc; **Victor Ching,** BSc, RN; **Miriam Grushka,** MSc, DDS, PhD

Posted on September 17, 2013

Tags: diagnosis oral conditions

Cite this as: ***J Can Dent Assoc* 2013;79:d86**

Revised on April 23, 2015

ABSTRACT

Taste disorders are distressing for patients. They can also pose a serious threat to the health of older and more vulnerable patients, who can become malnourished through a loss of taste or changes in taste perception. Despite the profound impact of taste changes on health, the literature on their diagnosis, pathogenesis and treatment is sparse. Taste changes, including the experience of unexplained foul tastes or a decrease in taste sensations, may lead patients to seek out inappropriate dental treatments, but such treatments are often unsuccessful in resolving the complaint. Correct diagnosis of taste loss is the first step in the treatment of taste abnormalities and the avoidance of unnecessary dental treatment. It is therefore helpful for both patient and health care provider to be aware of the causes of taste changes. This review presents an overview of the causes, diagnosis and management of taste abnormalities.

Taste disturbances can range from a total loss of taste to the constant presence of phantom tastes, such as a bitter or metallic taste in the absence of any offending substance in the mouth. Such disturbances and associated dietary alterations can lead to malnutrition (possibly resulting in death), obesity or other health issues, such as hypertension. Many patients who report the presence of a metallic taste opt to have a filling removed or replaced, believing the filling material to be the cause of the unpleasant taste, but such treatment often does not resolve the problem. Despite the discomfort and profound effect on quality of life caused by alteration or loss of taste, few definitive treatments for taste disturbances exist, partly because of the complexity of the taste system and partly because of a lack of substantive research on the topic. Taste disturbances can be classified into 4 main categories: hypogeusia (decreased sensitivity to taste modalities), dysgeusia (taste confusion), phantogeusia (phantom taste) and ageusia (loss of taste). Total loss of taste is rare.[1] Taste disturbances may occur secondary to autoimmune disease, inflammation, hormone imbalance, nerve-related damage, psychological problems (e.g., anorexia), medication therapy or malignancy; they may also occur as a result of natural aging.[2-4] (**Figs. 1** and **2**)

Fig 1. Tongue of patient with taste change due to inflammatory changes.

Fig 2. Toluidine blue staining of the tongue tip in same patient to visualize the taste buds.

In communicating their symptoms, patients often confuse taste changes with flavour changes. The 5 main tastes are described as salty, sweet, sour, bitter and umami. The last of these is a relatively new term for a taste described as savory, which is created by the combination of glutamate with 5´-ribonucleotides.[5] Loss of taste results specifically from a change in a person's response to any of the 5 taste modalities;in contrast, loss of the perception of flavour results from damage to the olfaction system or the trigeminal nerve, which supplies somatosensation to the oral and perioral tissues, with or without changes to taste. As an example of the distinction between taste and flavour, the taste of a strawberry can be described as a combination of sweet and sour, whereas its flavour is described as that of "a strawberry," a gestalt of taste, fragrance and somatosensation. In the case of flavour loss without measurable loss in taste function, the etiologic factor is usually a loss of olfaction through infection of the upper respiratory tract, natural aging, neurodegenerative disease, head trauma, or nasal and sinus disease.[6]

The Taste System

The taste system is complex, involving innervation of various anatomic structures by several cranial nerves. Cranial nerve VII (the facial nerve) innervates the anterior two-thirds of the tongue and soft palate through the chorda tympani and the greater petrosal nerve respectively, whereas cranial nerve IX (the glossopharyngeal nerve) innervates the posterior third of the tongue through the glossal branches and cranial nerve X (the vagus nerve) supplies sensation from the pharyngeal area. The anterior two-thirds of the dorsal tongue is covered with numerous filiform papille, with fungiform papillae scattered among them, mainly at the tip and along the lateral borders of the tongue. Large circular vallate papillae are located anterior and parallel to the sulcus terminalis, and the foliate papillae are found on the lateral borders of the tongue and are innervated by cranial nerve IX.[7]

Taste molecules are detected by chemosensitive taste receptors in the taste buds, which are located on the anterior and posterior tongue, the palate and the epiglottis. The taste buds contain 3 types of taste receptors: type I receptors detect salt taste; type II receptors detect sweet, bitter and umami tastes; and type III receptors detect sour taste.[8] Each taste bud may comprise 50 to 100 taste receptors.[9] Within the type II cells, the T1R family of taste receptors detects sweet and umami and can be found in the fungiform and circumvallate papillae[10] and the T2R family of taste receptors that detects bitter taste are found in the circumvallate and foliate papillae.[11] It has been suggested that the sour and salt receptors are ion channels.[11] Stimulation of the taste receptors generates signals that travel through cranial nerves VII, IX and XI to the gustatory nucleus in the medulla. Fibres of the lingual nerve anastomose with taste carrying branches of CN VII. Centrally, there are 2 pathways, one ascending to the hypothalamus and the other to the thalamus and then the gustatory centre of the cortex.[3,7,12] A disturbance at any point along these pathways can result in changes to taste sensation.[6]

Pathophysiology of Taste

Chemotherapy and radiotherapy can cause anatomic changes and death of taste bud cells through a higher rate of cell turnover, which is believed to be the basis of taste changes during cancer treatment.[13,14] In an animal model, Nguyen and colleagues[8] found that irradiation caused loss of taste progenitor cells and arrest of cell proliferation, which together led to decreased replacement after physiological loss of taste buds. It has also been hypothesized that secretion of chemotherapeutic agents in saliva or gingival crevice fluid can lead to taste disturbances by direct stimulation of taste receptors.[9] Damage to the salivary glands during cancer treatment or because of autoimmune disease such as Sjogren syndrome can lead to a loss of taste, since saliva is vital in transporting stimulants to the taste sensory cells.[1,2,6,15] It has been reported that 75% to 100% of patients who have undergone radiation therapy experience some taste abnormalities, with the severity being dependent on the treatment field.[9] Malnourishment resulting from decreased enjoyment of food may be responsible for death in up to 20% of cancer patients.[16] However, with advances in radiotherapy, such as parotid-sparing intensity-modulated radiotherapy, and the discovery of radioprotective agents such as amifostine, it may be possible to reduce the duration and severity of radiation-associated taste.[9]

In addition to physiological changes to the taste buds caused by infection or inflammation, damage to the signal transduction pathway can also lead to taste disturbances. Infection or inflammation may either decrease the number of taste bud cells by triggering apoptosis or may impede the ability of the chemosensitive hairs to detect taste stimulants.[3,13] The chorda tympani, which travel through the petrotympanic fissure, may be injured by ear surgery, by the presence of an ear tumour, laryngoscopy, dental surgery, infection, or trauma and such damage can cause changes in taste perception. Damage to the lingual branch of the glossopharyngeal nerve related to the tonsillectomy may also result in changes in taste perception.[1,3,17-19] Central changes affecting the gustatory nucleus in the medulla and the cortex, including infarction in the gustatory centre of the cortex, have been reported to be associated with taste changes.[3]

Systemic disorders such as Sjogren syndrome, hypertension, diabetes mellitus, renal disease, liver disease and thyroid disease can secondarily cause taste changes through neuropathy or changes to the oral environment.[1,2,6,20] Gondivkar and colleagues 21 found that approximately 80% of patients with uncontrolled diabetes and approximately 50% of those with controlled diabetes had

impairment of taste, mostly affecting the sweet, sour and salty tastes, possibly because of diabetes-related nerve injury. Patients with chronic kidney disease may report decreased salt sensitivity and are often found to be zinc deficient.[20] Taste changes are often drug related. For example, in one study, for approximately 25% of patients with taste disturbances at an ear, nose and throat outpatient clinic, the problem was drug-related.[22] Habbab and colleagues 23 found that cardiovascular agents alone had a 1.9% chance of causing dysgeusia.

Psychological factors may also contribute to changes in taste perception. For example, patients with anorexia had lower sensitivity to taste modalities, although sensitivity improved after treatment of the eating disorder.[24] Loss of taste in patients with anorexia might also be explained by the presence of unmet nutritional needs, given that low serum levels of iron or zinc have been reported to contribute to taste disturbances.[2,25-27]

In addition to medical conditions associated with changes in taste sensations, normal aging can also cause taste changes. In particular, lower taste sensitivity is common among elderly patients, possibly because of age-related changes in taste cells, decreased salivary production and inability to fully chew food.[4,6] However, among elderly patients, taste loss is more commonly caused by drug use, zinc deficiency, and oral and systemic disease than by normal aging.[28]

Diagnosis and Treatment of Taste Disorders

Determining the prognosis of a taste disorder and planning treatment can be difficult because identification of the cause often depends on the patient's history, and many patients are unaware of when the changes began. Dental causes of taste disturbances should be ruled out before assessment for any other causes. For example, a metallic taste caused by dental material can be easily corrected by replacing the offending material. Imaging studies, including computed tomography and magnetic resonance imaging, may be undertaken to look for structural changes and to assess the central nerves and potential intracranial causes,[6] but the results of such studies are often negative or ambivalent. In these cases, the diagnosis must be based on a thorough medical history, the patient's subjective reporting and psychophysical testing.

As noted above, a history of cancer treatment is often associated with taste abnormalities because of changes to the taste buds and/or the oral environment. Many patients who experience taste loss due to radiotherapy or chemotherapy recover completely within a few months to a year after completion of treatment.[15] However, some patients may not recover their taste for years after treatment and may eventually lose awareness of their taste dysfunction.[29] Patients with irreversible damage to the salivary glands as a result of radiation or surgical treatment may report taste loss, which can be ameliorated by measures to increase oral moisture; however, the literature on effectiveness of sialogogues is guarded.[15,30]

Patients may report abnormal tastes after starting a new medication. Medication-induced taste and smell changes have been reported to account for 0.4% of all reported adverse drug events.[31] It has been suggested that this type of adverse event occurs disproportionately in the older population; for example, in large surveys, 11% to 33% of elderly subjects (> 65 years old) self-reported drug-related taste changes.[32] Unfortunately, outside of a few case reports and cohort studies, there is scant literature describing the specific sensory complaints experienced during these drug reactions. The lack of psychophysical testing in such cases makes it difficult to determine whether the problem is related to taste only or to both taste and smell.

Numerous medications, representing almost all drug classes, have been reported to cause taste changes.[32] Medication-induced taste changes often resolve after cessation of the medication. Osaki and colleagues[27] reported that drug-induced dysgeusia caused by azelastine hydrochloride and furosemide reserpine resolved completely by 2 months after cessation of the drug therapy. Although a change in medication regimen can reduce dysgeusia, it may take months for taste to return to normal, presumably because of accumulated metabolites or changes to the taste system.[32] Some medication-induced taste changes are more difficult to resolve because the medications are required to address a serious systemic condition and cannot be stopped or changed.

Taste and smell function can be readily tested at chairside. The testing generally falls into 2 categories: taste testing, based on exposure to substances that produce salty, sweet, sour bitter, and umami tastes; and smell testing, based on exposure to common smells assumed to be known to the person.[33] Commercial kits are increasingly available for bedside or chairside testing, but a description of these kits is beyond the scope of the current review. When a patient presents with a taste complaint, what is important is to investigate whether there has indeed been a change in taste function and to rule out smell abnormalities as being partially or fully responsible for the sensory change.

Smell testing can be accomplished by asking patients to identify common smells (e.g., chocolate, coffee, mothballs) after exposure (one nostril at a time). A deficit in smell function, either bilaterally or unilaterally, may be related to an obstruction in the sinuses or to an insidious neurological process, the latter requiring further medical work-up.

Treatment of Idiopathic Dysgeusia

Few studies have reported effective treatment for patients with idiopathic or persistent taste disturbance. In these cases, zinc

supplementation can be prescribed.[34,35] However, patients should be counselled that the results are not instantaneous, and it may take a number of months before any improvement will be seen. In previous studies, zinc gluconate (50 mg 3 times daily) had a positive effect on taste disorders in a zinc-deficient population and also in patients with idiopathic taste loss regardless of serum zinc level.[34,35] Zinc supplementation is believed to aid in treating taste disorders by promoting proliferation of normal taste bud cells, even in patients without zinc deficiency.[35]

Alpha-lipoic acid, an important coenzyme and antioxidant in many cellular pathways within the body, has also been suggested for treating idiopathic dysgeusia. Femiano and colleagues[36] found that 91% of patients with idiopathic dysgeusia who took α-lipoic acid (200 mg every 8 hours) showed some improvement, and 46% experienced total resolution. These authors suggested that α-lipoic acid may mitigate or reverse the neuropathic changes related to idiopathic dysgeusia.[36]

Animal studies have suggested that gammaaminobutyric acid (GABA)-ergic drugs modify taste function.[37] Clonazepam, which is a GABA type A receptor agonist, may be helpful for treating phantom tastes and has been effective in treating phantogeusia and dysgeusia associated with burning mouth syndrome.[38] Use of repetitive transcranial magnetic stimulation has also been suggested as treatment, although the evidence remains limited.[39]

Fujiyama and colleagues [40] reported improvement in salt, sweet, sour and bitter tastes in an 80-year-old woman who started holding an ice cube in her mouth before meals. These authors suggested using the use of ice cubes to treat taste disturbances, on the basis of a study indicating that the transient receptor potential M5 (TRPM5), which are highly expressed in taste buds, are sensitive to temperature.[40] For patients with unpleasant phantom tastes or a lowered taste threshold, reducing the intake of metallic or bitter foods such as meat, coffee or tea and eating more mild-flavoured foods such as chicken, dairy and eggs may help with the enjoyment of food; cooling foods before eating may reduce unpleasant flavours and odours.[16]

Improving Food Flavours in Taste Loss

Flavour enhancement may be suggested for patients with taste loss, as this approach can increase enjoyment of food in cases of insufficient nutritional intake and decreased taste sensitivity. Among elderly patients with decreased taste sensitivity, increasing the flavour of food by adding glutamate for saltiness,[41,42] marinating meats before cooking,[43] using low-calorie sweetener to enhance sweetness and using lemon juice to enhance sourness has increased the amount of food consumed.[44,45] Patients should be counselled about proper nutrition, supplementation and eating regular meals and should be followed for compliance[43] with dietary guidelines to maintain health.

Conclusions

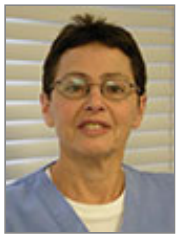
Few studies have demonstrated effective treatment for the loss or distortion of taste. The availability of testing for the integrity of taste and smell remains limited, and patients are often subjected to unnecessary and sometimes irreversible and damaging treatment of teeth and other oral mucosal tissues. Conversely, increased recognition that most taste abnormalities originate within the taste system rather than from external stimuli (e.g., a leaky filling, infected tooth or periodontal disease) may prevent unnecessary treatment by dentists who are trying to alleviate their patients' suffering.

THE AUTHORS

Ms. Su *is a medical student at Norman Bethune College of Medicine, Jilin University, Changchun, China.*

Mr. Ching *is a registered nurse at Manitoulin Health Centre, Manitoulin, Ontario.*

Dr. Grushka *is courtesy associate professor, dentistry, University of Florida, Gainesville, Florida. She is a certified specialist in oral medicine in Ontario and B.C. and a diplomate of the American Board of Oral*



Medicine and the American Board of Orofacial Pain.

Correspondence to: *Dr. Miriam Grushka, 974 Eglinton Ave W., Toronto, ON M6C 2C5. Email: miriamgrushka@gmail.com*

The authors have no declared financial interests.

This article has been peer reviewed.

References

1. Mann MN. Management of smell and taste problems. *Cleve Clin J Med.* 2002;69(4):329-36.
2. Thawley SE. Disorder of taste and smell. *South Med J.* 1978;71(3):267-70.
3. Walker HK, Hall WD, Hurst JW. *Clinical Methods: the History, Physical, and Laboratory Examination*. 3rd ed. Boston: Butterworths; 1990. p. 22-6.
4. Boyce JM, Shone GR. Effects of ageing on smell and taste. *Postgrad Med J.* 2006;89:239-41.
5. Yamaguchi S, Ninomiya K. Umami and food palatability. *J Nutr.* 2000;130(4S Suppl):921S-6S.
6. Bromley SM. Smell and taste disorders: A primary care approach. *Am Fam Physician.* 2000;61(2):427-36,438.
7. Liebgott B. The anatomical basis of dentistry. 2nd ed. St. Louis (MO): Mosby, Inc. 2001.
8. Nguyen HM, Reyland ME, Barlow LA. Mechanisms of taste bud cell loss after head and neck irradiation. *J Neurosci.* 2012;32(10):3474-84.
9. Epstein JB, Barasch A. Taste disorders in cancer patients: pathogenesis, and approach to assessment and management. *Oral Oncol.* 2010;46(2):77-81.
10. Suzuki T. Cellular mechanisms in taste buds. *Bull Tokyo Dent Coll.* 2007;48(4):151-61.
11. Bachmanov AA, Beauchamp GK. Taste receptor genes. *Annu Rev Nutr.* 2007;27:389-414.
12. Naik BS, Shetty N, Maben EV. Drug-induced taste disorders. *Eur J Intern Med.* 2010;21:240-3.
13. Wang H, Zhou M, Brand J, Huang L. Inflammation and taste disorders: mechanisms in taste buds. *Ann NY Acad Sci.* 2009;1170(1):596-603.
14. Hovan AJ, Williams PM, Stevenson-Moore P, Wahlin YB, Ohrn KE, Elting LS, et al. A systemic review of dysgeusia induced by cancer therapies. *Support Care Cancer.* 2010;18(8):1081-7.
15. Ruo Redda MG, Allis S. Radiotherapy-induced taste impairment. *Cancer Treat Rev. 2006;32(7):541-7.* Epub 2006 Aug 2.
16. Hong JH, Omur-Ozbek P, Stanek BT, Dietrich AM, Duncan SE, Lee YW, et al. Taste and odor abnormalities in cancer patients. *J Support Oncol.* 2009;7(2):58-65.
17. Goins MR, Pitovski DZ. Posttonsillectomy taste distortion: a significant complication. *Laryngoscope.* 2004;114(7):1206-13.
18. Windfuhr JP, Sack F, Sesterhenn AD, Landis BN, Chen YS. Post-tonsillectomy taste disorder. *Eur Arch Otorhinolargyngol.* 2010;267(2):289-93.
19. Landis BN, Scheibe M, Weber C, Berger R, Brämerson A, Bende M, et al. Chemosensory interaction: acquired olfactory impairment is associated with decreased taste function. *J Neurol.* 2010;257(8):1303-8.
20. Kusaba T, Mori Y, Masami O, Hiroko N, Adachi T, Sugishita C, et al. Sodium restriction improves the gustatory threshold for salty taste in patients with chronic kidney disease. *Kidney Int.* 2009;76(6):638-43.
21. Gondivkar SM, Indurkar A, Degwekar S, Bhowate R. Evaluation of gustatory function in patients with diabetes mellitus type 2. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2009;108(6):876-80.
22. Tomita H, Yoshikawa T. Drug-related taste disturbances. *Acta Otolaryngol Suppl. 2002;(546):116-21.*
23. Habbab KM, Mole DR, Porter SR. Potential oral manifestations of cardiovascular drugs. *Oral Dis. 2010;16(8):769-73.*
24. Aschenbrenner K, Scholze N, Joraschky P, Hummel T. Gustatory and olfactory sensitivity in patients with anorexia and bulimia in the course of treatment. J Psychiatr Res. 2008;43(2):129-37.
25. Casper RC, Kirschner B, Sandstead HH, Jacob RA, Davis JM. An evaluation of trace metals, vitamins, and taste function in anorexia nervosa. *Am J Clin Nutr.* 1980;33(8):1801-8.

26. Fukasawa T, Orii T, Tanaka M, Suzuki N, Kanzaki Y. Relation between drug-induced taste disorder and chelating behavior with zinc ion; statistical approach to the drug-induced taste disorder, part II. *Chem Pharm Bull (Tokyo).* 2008;56(8):1177-80.

27. Osaki T, Ohshima M, Toita Y, Matsugi N, Nomura Y. Clinical and physiological investigations in patients with taste abnormality. *J Oral Pathol Med. 1996;25(1):38-43*.

28. Imoscopi A, Inelmen EM, Sergi G, Miotto F, Manzato E. Taste loss in the elderly: epidemiology, causes and consequences. *Aging Clin Exp Res. 2012;245(6):570-9*.

29. McLaughlin L. Taste dysfunction in head and neck cancer survivors. *Oncol Nurs Forum. 2013;40(1):E4-13*.

30. Jham BC, Chen H, Carvalho AL, Freire AR. A randomized phase III prospective trail of bethanechol to prevent mucositis, candidiasis, and taste loss in patients with head and neck cancer undergoing radiotherapy: a secondary analysis. *J Oral Sci.* 2009;51(4):565-72.

31. Tuccori M, Lapi F, Testi A, Ruggiero E, Moretti U, Vannacci A, et al. Drug-induced taste and smell alterations: a case/non-case evaluation of an italian database of spontaneous adverse drug reaction reporting. *Drug Saf.* 2011;34(10):849-59.

32. Doty RL, Shah M, Bromley SM. Drug-induced taste disorders. *Drug Saf.* 2008;31(3):199-215.

33. Hummel T, Rissom K, Reden J, Hähner A, Weidenbecher M, Hüttenbrink KB. Effects of olfactory training in patients with olfactory loss. *Laryngoscope.* 2009;119(3):496-9.

34. Heckmann SM, Hujoel P, Habiger S, Friess W, Wichmann M, Heckmann JG, et al. Zinc gluconate in the treatment of dysgeusia–a randomized clinical trial. *J Dent Res.* 2005;84(1):35-8.

35. Takaoka T, Sarukura N, Ueda C, Kitamura Y, Kalubi B, Toda N, et al. Effects of zinc supplementation on serum zinc concentration and ratio of apo/holo-activities of angiotensin converting enzyme in patients with taste impairment. *Auris Nasus Larynx.* 2010;37(2):190-4.

36. Femiano F, Scully C, Gombos F. Idiopathic dysgeusia; an open trial of alpha lipoic acid (ALA) therapy. *Int J Oral Maxillofac Surg.* 2002;31(6):625-8.

37. Starostik MR, Rebello MR, Cotter KA, Kullik A, Medler KF. Expression of GABAergic receptors in mouse taste receptor cells. PLoS One. 2010;5(10):e13639.

38. Grushka M, Epstein J, Mott A. An open-label, dose escalation pilot study of the effect of clonazepam in burning mouth syndrome. *Oral Surg Oral Med Oral Pathol Radiol Endod. 1998;86(5):557-61*.

39. Henkin RI, Potolicchio SJ Jr, Levy LM. Improvement in smell and taste dysfunction after repetitive transcranial magnetic stimulation. *Am J Otolaryngol. 2011;32(1):38-46*.

40. Fujiyama R, Ishitobi S, Honda K, Okada Y, Oi K, Toda K. Ice cube stimulation helps to improve dysgeusia. *Odontology. 2010;98(1):82-4*.

41. Ball P, Woodward D, Beard T, Shoobridge A, Ferrier M. Calcium diglutamate improves taste characteristics of lower-salt soup. *Eur J Clin Nutr.* 2002;56(6):519-23.

42. Halpern BP. Glutamate and the flavor of food. *J Nutr.* 2000;130(4S suppl):910S-4S.

43. Ravasco P. Aspects of taste and compliance in patient with cancer. *Eur J Oncol Nurs.* 2005;9(Suppl 2):S84-91.

44. Schiffman SS, Warsick ZS. Flavor enhancement of foods for the elderly can reverse anorexia. *Neurobiol Aging.* 1988;9(1):24-6.

45. Schiffman SS, Warwick ZS. Effect of flavor enhancement of foods for the elderly on nutritional status: food intake, biochemical indices, and anthropometric measures. *Physiol Behav.* 1993;53(2):395-402.