

Original Article

# The lost and Found Taste Sensation Following Middle Ear Surgery

Sai Belsare<sup>1</sup>, Arun Dehadaray<sup>1</sup>, Kartikeya Chauhan<sup>1</sup>

<sup>1</sup>Department of Otorhinolaryngology, Bharati Vidyapeeth (Deemed to be university) Medical College, Pune, India

## ABSTRACT

**Objectives:** To evaluate taste sensation in patients undergoing middle ear surgeries like tympanoplasty, mastoidectomy and stapedotomy subjectively and by chemical gustometry. To assess the recovery of taste sensation and duration required and to find out if the recovery of taste sensation is at peripheral or cortical level.

**Material and Methods:** Subjective evaluation and chemical gustometry to assess taste sensation pre operatively and on post operative day 1, day 8, 3 months and 6 months in 179 patients undergoing middle ear surgery.

**Results:** A transient loss of taste was seen to occur in 43% cases when chorda was preserved on post operative day 1, however 100% recovery to normal taste was seen at 3 months. In all 30 cases in whom chorda was stretched, on immediate post operative day 1 and also on day 8, none of the patients had taste on gustometry. However at 6 months 75% had normal taste function on gustometry and subjectively 100% patients showed recovery. Of the 69 patients in whom chorda was severed, on post operative day 1, only 3 patients had taste sensation both subjectively and on gustometry. At 3 months 34 patients had subjective taste sensation and gustometry showed ipsilateral taste only in 6 patients. At 6 months post operatively 53 patients showed taste sensation subjectively however gustometry showed taste only in 16 patients.

**Conclusion:** Taste evaluation in patients undergoing middle ear surgery has revealed that when chorda is preserved there is no change of taste, if chorda is stretched all patients are asymptomatic for complains of taste disturbance at 6 months. For patients in whom chorda is cut, subjectively taste recovery is seen in 84% patients although on chemical gustometry it is seen in only 30% which could be due to cortical compensation, probably due to the encroachment of the cortical taste area of the glossopharyngeal nerve over the cortical representation of taste by the chorda.

**Keywords:** Chemical gustometry, Chorda tympani, Cortical compensation

## INTRODUCTION

Taste disturbance due to damage to the chorda tympani nerve is an important complaint in patients undergoing middle ear surgery. The sense of taste is a specialized chemosensory system that is mediated via three cranial nerves: the chorda tympani-branch of the facial nerve, the glossopharyngeal nerve, and the vagus. The central processes of these 3 nerves form the tractus solitaries, which ascend in the medial lemniscus to the thalamus and finally through the internal capsule into the sensory-gustatory cortex and insula. Local projections from the nucleus of the solitary tract (NST) within the brainstem mediate low-level (i.e., noncortical) show effects of behavioral responses.<sup>1</sup> At most centers, the chorda is preserved in most tympanoplasty cases, and it may either be stretched or severed during stapedotomy

or mastoidectomy surgery. Chemical gustometry is a widely used method to evaluate taste function; its reliability and validity have been documented in many clinical studies, and this was used in our study. This study was done to evaluate taste disturbances in patients following different middle ear surgeries in which chorda was either preserved, stretched, severed, or not identified. The study relates the loss of taste function immediately after surgery based on the handling of the chorda tympani nerve and also assesses the duration required for this taste sensation to return both subjectively and on gustometry. The study is an attempt to identify the mechanism of subjective recovery of taste sensation and to find out if it is at the peripheral or cortical level.

\*Corresponding author: Sai Belsare, Department of Otorhinolaryngology, Bharati Vidyapeeth (Deemed to be university) Medical College, Pune, India. [belsaresai93@gmail.com](mailto:belsaresai93@gmail.com)

Received: 20 April 2021 Accepted: 06 May 2021 Published: 31 January 2025 DOI: 10.25259/AONO-2021-5-(143)

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms. ©2025 Published by Scientific Scholar on behalf of Annals of Otolaryngology and Neurotology

## MATERIAL AND METHODS

The study was conducted after approval from the institute's Ethics Committee. Written informed consent was obtained from all the participants. This was a prospective study that included patients coming to the ENT department of a tertiary care teaching hospital from August 2017 to April 2019. A total of 179 patients between the ages 12–65 years were posted for a middle ear surgery, i.e., tympanoplasty, mastoid surgery, and stapedotomy, and those who were willing to undergo taste evaluation were included in the study. A detailed history and thorough ENT examination were done for each patient.

Subjective assessment of taste was done by asking the patient if there was a reduced taste sensation noticed by the patient during the eating of food. Chemical gustometry was done using 4 solutions. Sweet (a super-saturated solution of sugar in water), salty (a super-saturated solution of common salt in water), sour (fresh lemon juice), and bitter solution (concentrated solutions of coffee beans in water) were used. The standardization of the solution was done by testing them on five normal subjects fitting the age criteria and by excluding those with systemic disorders.

Each solution was tested separately on the right as well as the left half of the tongue in 4 regions by using a micropipette of 10 microlitres as a fixed dose. [Figure 1].<sup>2,3</sup> Patient was asked to raise their mouth after each test. The responses of the patient were noted under 3 categories: present, absent, or reduced as compared to the opposite side. This test was carried out preoperatively and on day 1, day 8, 3 months, and 6 months postoperatively. Taste was considered present when all 4 tastes (sweet, salty, sour, and bitter) were perceived. Taste was considered absent when all four tastes were not perceived by the patient.

The inter-group statistical comparison of the distribution of categorical variables was tested using the Chi-Square test or Fisher's exact probability test. The intra-group statistical comparison of the distribution of categorical variables was done using Wilcoxon's signed rank test. *P*-values less than 0.05 were considered to be statistically significant.

## RESULTS

Of 179 cases studied, 35 (19.6%) had an age between 11 and 20 years, 95 (53.1%) had an age between 21 and 40 years, and 49 (27.3%) had an age more than 40 years. Of 179 cases studied, 76 (42.5%) were males and 103 (57.5%) were females. The male-to-female sex ratio in the study group was 0.74:1.0. Of 179 cases studied, 95 (53.1%) had Tympanoplasty done, 24 (13.4%) had Cortical mastoidectomy with Tympanoplasty, 54 (30.2%) had Modified radical mastoidectomy with Tympanoplasty and 6 (3.4%) underwent Stapedotomy.



Figure 1: Chemical gustometry kit.

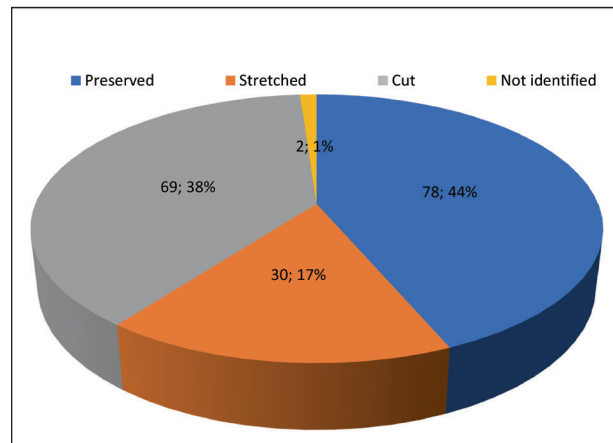


Figure 2: Fate of chorda tympani in different middle ear surgeries.

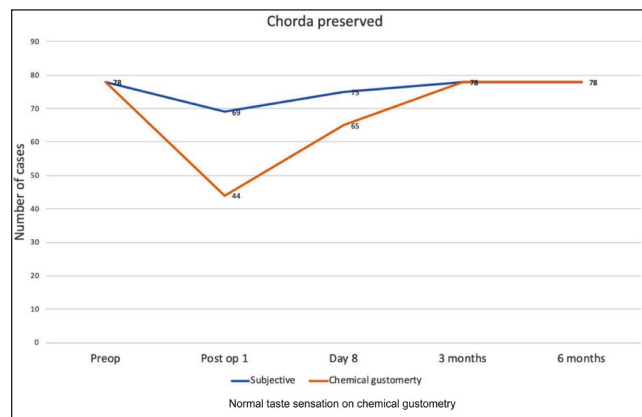


Figure 3: Taste evaluation in cases with chorda preserved.

Of 179 cases studied, in 78 (43.6%) chorda was preserved, 30 (16.8%) had stretched, 69 (38.6%) had cut, and in 2 patients (1.1%), chorda was not identified [Figure 2].

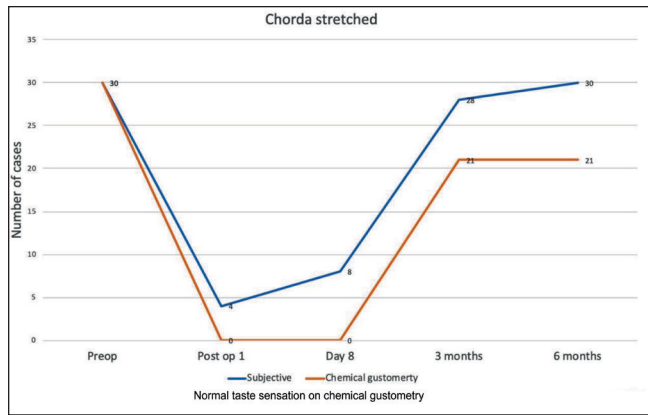


Figure 4: Taste evaluation in cases with chorda stretched.

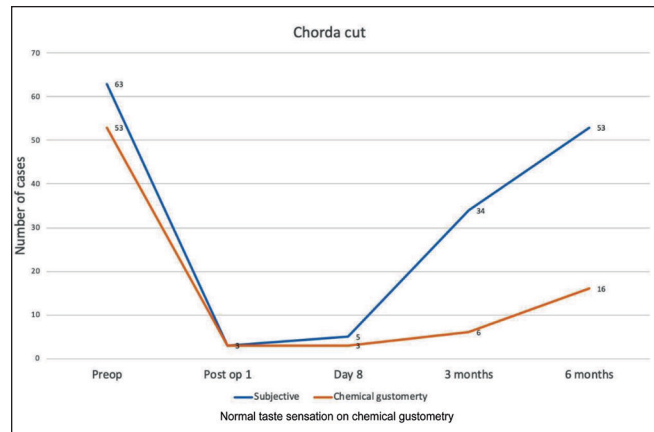


Figure 5: Taste evaluation in cases with chorda sacrificed.

Table 1: Subjective taste evaluation.

	Chorda preserved (n = 78)	Chorda stretched (n = 30)	Chorda cut (n = 69)	Chorda not identified (n = 2)	P-value
Preoperatively	78	30	63	2	0.001***
Postoperative day 1	69	4	3	0	0.001***
Postoperative day 8	75	8	5	0	0.001***
Postoperative 3 months	78	28	34	2	0.001***
Postoperative 6 months	78	30	53	2	0.001***

\*\*\* Signifies P value calculated as per software by statistician, rounded off to 3 decimals.

Table 2: Taste evaluation using chemical gustometry.

	Chorda preserved (n = 78)	Chorda stretched (n = 30)	Chorda cut (n = 69)	Chorda not identified (n = 2)	P-value
Preoperatively	78	30	53	2	0.001***
Postoperative day 1	44	0	3	0	0.001***
Postoperative day 8	65	0	3	0	0.001***
Postoperative 3 months	78	21	6	2	0.001***

\*\*\* Signifies P value calculated as per software by statistician, rounded off to 3 decimals.

Of the 78 cases in whom chorda was preserved preoperatively, the taste was normal in all patients subjectively and on gustometry. On a postoperative day 1, normal taste on the ipsilateral side was seen subjectively in 69 and on gustometry in 44. Taste gradually improved on day 8, further improvement was seen at 3 months, and normal taste at the end of 6 months was documented [Figure 3].

In the 30 patients in whom chorda was stretched, on postoperative day 1, only 4 patients could perceive taste subjectively, and none had tasted on gustometry on the ipsilateral side. On day 8, 8 patients had taste sensations, and this further improved at 3 months, and at 6 months, all 30 patients had normal taste subjectively, and 21 had

normal taste perception on chemical gustometry [Figure 4]. Of the 69 patients in whom chorda was cut, preoperatively subjective taste on the ipsilateral side was normal in 63 patients and on gustometry in 53 patients. On postoperative day 1, only 3 patients had taste sensations both subjectively and on gustometry. On day 8, there wasn't much change; at 3 months, 34 patients had subjective taste sensation, and gustometry showed ipsilateral taste only in 6 patients. At 6 months postoperatively, 53 patients showed taste sensation subjectively; however, gustometry showed taste only in 16 patients [Figure 5]. The subjective and objective evaluation of taste sensation was assessed statistically which can be seen in Tables 1 and 2.

In the 2 patients in whom chorda wasn't identified, a taste sensation wasn't perceived subjectively and on gustometry on postoperative days 1 and 8; however, complete recovery was seen at 3 months.

## DISCUSSION

The chorda tympani, which carries taste sensation from the anterior two-thirds of the same side of the tongue, enters the middle ear through the medial surface of the petrotympanic fissure through a separate anterior canaliculus (canal of Huguier). At this location, lateral to the pyramidal eminence, the chorda tympani is initially encountered on elevating the annulus of the tympanic membrane. In underlay tympanoplasty and stapedotomy surgery, there is always a possibility of stretching or damaging the chorda tympani nerve. During open cavity mastoid surgery, the posterior and superior wall of the bony external meatus is removed, and the bone over the vertical part of the facial nerve (i.e., the facial ridge) is lowered to allow complete visualization and clearance of the cholesteatoma. The chorda tympani leaves the vertical part of the facial nerve and passes through the posterior wall of the bony meatus, lateral to the main trunk of the facial nerve. Here, the chorda tympani is inevitably sacrificed in mastoid surgeries for adequate lowering of the facial ridge.

In our study, preoperatively taste assessment revealed that out of the 179 patients included, sensation on the ipsilateral side was normal subjectively in 173 patients and on gustometry in 157 patients. All of these cases where taste was reduced before the surgery were cases of active squamosal chronic otitis media (COM), i.e., of the 54 patients with unsafe ear pathology,<sup>6</sup> were symptomatic for reduced taste, and gustometry showed reduced taste in 32 patients. All the remaining patients had a normal taste function subjectively and on gustometry. Previous studies by Goyal *et al.* and Sakaguchi have shown that chronic otitis media produces histopathologic alterations like fibrous thickening of epineural and perineural connective tissues along with the proliferation of fibroblasts around the chorda, which can explain the reduction in taste.<sup>3-5</sup> A transient loss of taste was seen to occur in 43% of cases when chorda was preserved on postoperative day 1. However, 100% recovery to normal taste was seen at 3 months. The chorda is unknowingly touched or tugged without the surgeon's awareness of the existence of the nerve in the surgical field, and this can lead to a temporary reduction in the conduction of electrical impulses, which recovers when oedema subsides.

It was seen in all 30 cases in whom chorda was stretched on immediate postoperative day 1 and also on day 8; none of the patients had tasted on gustometry. However, at 6 months, 75% had normal taste function on gustometry, and subjectively, 100% of patients showed recovery. In the case of chronic suppurative otitis media (CSOM), the tympanic

membrane gets thickened and can adhere to the nerves; hence, when the epithelial layer of the eardrum is elevated, the chorda tympani nerve may be indirectly tugged or stretched. Blunt trauma to the chorda can produce a temporary block in the conduction of impulses, but it leaves an intact axonal transport system, a state of neuropraxia from which complete functional recovery is seen.<sup>5,6</sup>

Of the 69 patients in whom chorda was severed, on postoperative day 1, only 3 patients had taste sensations both subjectively and on gustometry. This could be due to dual innervation of the anterior 2/3<sup>rd</sup> of the tongue from the opposite chorda or from the same side glossopharyngeal nerve, which was also stated by a study by Andrea Ciafalo *et al.*<sup>5</sup> in 2015.

On day 8, there wasn't much change. However, at 3 months, 34 patients had subjective taste sensation, and gustometry showed ipsilateral taste only in 6 patients. At 6 months postoperatively, 53 patients showed taste sensation subjectively; however, gustometry showed taste only in 16 patients [Figure 4].

There are studies done in monkeys where the thalamocortical projections of the gustatory system were traced. After passing through the parvocellular division of the ventroposteromedial nucleus of the thalamus, the efferent fibers were traced to be going to two areas of the cortex. The primary efferent was seen to be going to the ipsilateral insular opercular cortex, extending up to the orbitofrontal cortex, while another projection was seen going to the primary somatosensory cortex, which was subadjacent to the anterior subcentral sulcus. The proximity of the gustatory and somatosensory areas both in the ventrobasal thalamus and precentral gyrus has helped to consider that a small area of the cortex on the lateral convexity has overlapping projections from the gustatory pathway.<sup>7-11</sup> Based on all the above studies, we cannot deny the possibility of a form of taste neurospasticity where the cortical gustatory function, which is represented from the chorda, is taken over by the glossopharyngeal and the vagus nerve. As a result of this, the patient is not symptomatic, even though the chorda was severed during the surgery. This can also explain why 53 out of 69 patients in whom chorda was severed had an absent taste sensation on gustometry but was asymptomatic clinically at 6 months. In our study, we had 4 patients who underwent bilateral modified radical mastoidectomy with an interval of 6 months between the 2 sides. 3 out of 4 patients were subjectively asymptomatic for loss of taste sensation at the end of 6 months. On examination, the patients couldn't perceive taste on any taste gustometry on either side.

According to many authors, the chorda tympani inhibits the glossopharyngeal nerve; therefore, due to the cutting of the chorda, there may be a loss of this inhibition, and this will lead to taking over the function of taste sensation of the



anterior two-third of the tongue. This can explain how 16 patients had complete recovery of taste subjectively and on gustometry at the end of 6 months.<sup>12,13</sup>

## CONCLUSION

This study has made us more confident in counseling and reassuring patients regarding the consequences of chorda tympani handling and sacrificing during different middle ear surgeries, as only a very small percentage of patients had any permanent taste disturbance.

At the end of 6 months, all the patients in whom chorda was stretched had complaints about taste disturbance. In the patients whose chorda was cut, subjective taste recovery was seen in 84% of patients. However, on chemical gustometry, taste recovery was seen in 30% of these patients. This discrepancy can be due to cortical compensation. Neurological studies in the form of functional MRI can explain and take this research to the next level.

**Ethical approval:** The research/study approved by the Institutional Ethics Committee at Bharati Vidyapeeth Medical college, number 5603/2017-18, dated 5th January 2018.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent

**Financial support and sponsorship:** Nil.

**Conflicts of interest:** There are no conflicts of interest.

**Use of artificial intelligence (AI)-assisted technology for manuscript preparation:** The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

## REFERENCES

1. Kiverniti E, Watters G. Taste Disturbance After Mastoid Surgery: Immediate and Long-Term Effects of Chorda Tympani Nerve Sacrifice. *J Laryngol Otol* 2012;126:34–7.
2. Scott Brown's. *Otorhinolaryngology Head and Neck Surgery*. 8th ed. In: Watkinson JC, Clarke RW, editors. Boca Raton: CRC Press; 2018.
3. Goyal A, Singh PP, Dash G. Chorda Tympani in Chronic Inflammatory Middle Ear Disease. *Otolaryngol Head Neck Surg* 2009;140:682–6.
4. Maeda E, Katsura H, Nin T, Sakaguchi-Fukunaga A, Mishiro Y, Sakagami M. Change of Somatosensory Function of the Tongue Caused by Chorda Tympani Nerve Disorder After Stapes Surgery. *Laryngoscope* 2018;128:701–6.
5. Ciofalo A, Zambetti G, Romeo M, Vestri AR, Iannella G, Re M, Magliulo G. Taste and Olfaction in Middle Ear Surgery. *Ann Otol Rhinol Laryngol* 2015;124:312–6.
6. Clark MP, O'Malley S. Chorda Tympani Nerve Function After Middle Ear Surgery. *Otol Neurotol* 2007;28:335–40.
7. Pritchard TC, Hamilton RB, Morse JR, Norgren R. Projections of thalamic Gustatory and Lingual Areas in the Monkey, *Macaca fascicularis*. *J Comp Neurol* 1986;244:213–28.
8. Kringelbach ML, de Araujo IE, Rolls ET. Taste-Related Activity in the Human Dorsolateral Prefrontal Cortex. *Neuroimage* 2004;21:781–8.
9. Kobayakawa K, Kobayakawa R, Matsumoto H, Oka Y, Imai T, Ikawa M, et al. Innate versus Learned Odour Processing in the Mouse Olfactory Bulb. *Nature* 2007;450:503.
10. Kringelbach ML, de Araujo IE, Rolls ET. Taste-Related Activity in the Human Dorsolateral Prefrontal Cortex. *Neuroimage* 2004;21:781–8.
11. Small DM. Central Gustatory Processing in Humans. in: *Taste and Smell* (Vol. 63). Karger Publishers; 2006. p. 191–220.
12. Saito T, Manabe Y, Shibamori Y, Yamagishi T, Igawa H, Tokuriki M, et al. Long-Term Follow-Up Results of Electrogustometry and Subjective Taste Disorder After Middle Ear Surgery. *Laryngoscope* 2001;111:2064–70.
13. Shibamori Y, Igawa H, Saito T, Manabe Y, Ohtsubo T, Yamagishi T, Saito H. Incidence of Regeneration of the Chorda Tympani Nerve After Middle Ear Surgery. *Ann Otol Rhinol Laryngol* 2002;111:357–63.

**How to cite this article:** Belsare S, Dehadaray A, Chauhan K. The Lost and Found Taste Sensation Following Middle Ear Surgery. *Ann Otol Neurotol*. 2025;6:e004. doi: 10.25259/AONO-2021-5-(143)