

# Gustatory function in chronic otitis media (mucosal type) before and after tympanoplasty

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**Abstract** Chronic inflammation in the middle ear may result in functional impairment of the chorda tympani nerve, which carries taste from the anterior two-thirds of the tongue. This may lead to impaired taste sensation. Timely intervention and adequate disease clearance may help the chorda tympani nerve to recover. Gustatory function of 107 patients who underwent Tympanoplasty for Chronic otitis media (mucosal type) was evaluated in a cohort of Indian patients. To compare the preoperative and postoperative gustatory function in these patients taste scores were documented preoperatively, and at 6 weeks and 3 months postoperatively, in an effort to document taste function improvement after disease clearance. The taste scores thus obtained were recorded and analyzed. A significant improvement in taste threshold postoperatively in comparison to the preoperative taste scores ( $p = 0.001$ ) was found. It was observed that age of the patient and duration of illness have a significant impact on the recovery of taste function. Our study suggests that taste perception improves over a period of time after successful tympanoplasty in patients with chronic otitis media (mucosal type).

**Keywords** Gustatory function · Taste · Chronic otitis media · Tympanoplasty · Chorda tympani nerve

## Introduction

Taste plays the most important role in relishing food. Chronic inflammation in the middle ear may result in functional impairment of the chorda tympani nerve which travels unprotected in the middle ear cavity [1–3]. Though patients suffering from chronic otitis media (COM) seldom complain of taste disturbance, testing of gustatory function by quantitative methods in various studies have revealed an elevation of taste threshold in these patients [1]. This study was done to evaluate whether there was any change in gustatory function after clearance of the disease by Tympanoplasty in patients with Chronic otitis media (mucosal type).

## Materials and methods

The study conformed to the guidelines of our institutional ethics committee. It was conducted in the department of Otorhinolaryngology and Head and Neck Surgery, RL Jalappa Hospital and Research Centre, Tamaka, Kolar. This is a prospective observational study. Patients presenting to the department of ENT who were diagnosed with chronic otitis media (mucosal type), and willing to undergo tympanoplasty were included in the study. An informed written consent was obtained for both Tympanoplasty and to include the patient into the study. Details of the cases can be found in table v uploaded as supplemental material.

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## Exclusion criteria

Patients who had previous history of ear surgery; patients in whom chorda tympani nerve was inadvertently injured during surgery; patients with dysosmia; pregnancy; cognition barrier; history of alteration in taste function; patients below 16 years of age and tympanoplasty failures.

## Data collection

Evaluation of gustatory function was done using taste solutions of different concentrations mentioned in Table 1. The concentration of taste solutions was determined based on previous studies conducted by Mueller et al., and Huan and colleagues [4, 5].

Patients were instructed not to consume any food or drink half an hour prior to testing. Using a pipette, 3 drops of one taste solution was placed on the lateral aspect of the diseased side on the anterior 2/3rd of the partially outstretched tongue starting from the lowest concentration. If the patient was able to identify the taste correctly, once, it was taken as a positive result and a score was allotted. If the patient was unable to identify the taste, a solution of higher concentration was used. In this way score was allotted for different taste solutions depending on the concentration at which the patient was able to recognize the taste. After testing with each solution, the patient was asked to rinse his/her mouth to wash out any residual taste molecules prior to using the next solution. Scores were allotted for each taste class, the minimum score being 1 and maximum being 5 per taste class. Lower the score of the patient better the gustatory function. The minimum overall score a patient could get was 4 and, 20 the maximum. Different classes of taste were presented in a random order except bitter solution which was presented as the last to minimize the unpleasant sensation and hence ensure better cooperation of the patient. Results of gustatory testing for all patients were documented and analyzed. Change in taste, subjectively as perceived by the patient was not analyzed.

## Statistical analysis

We used the IBM SPSS software (v.22) to perform the statistical analysis. The collected data were analyzed using descriptive statistics like mean, standard deviation, and proportions. The significance of difference in the taste scores between preoperative period and at 6 weeks and 3 months were done using Student's paired *t* test. Comparison of taste scores at 6 weeks and 3 months postoperative period was done by Chi-squared test. ANOVA was applied to test for statistically significant difference between taste scores of different groups for analyzing effect of age and duration of illness. *p* value less than or equal to 0.05 was considered significant.

## Results

### Influence of tympanoplasty on preoperative and postoperative taste scores

A total of 107 patients were included in the study. There were 59 male and 48 female patients. Age of the patients ranged from 16 to 76 years with mean age of 33.2 years. The mean preoperative taste score was 12.35 with a standard deviation (SD) of 2.61. However, when we compared this with the mean taste score 6 weeks postsurgery, the taste threshold decreased to 10.67 (Table 2). This meant that within 6 weeks after disease removal, taste sensation improved significantly. While the same analysis was done after 3 months post-tympanoplasty, mean taste threshold decreased further to 9.96 suggesting a trend towards further improvement in taste function.

Therefore there is a statistically significant improvement in taste function at 6 weeks and at 3 months postoperatively.

### Influence of age on taste threshold with tympanoplasty

We were interested to know if the recovery in taste function is age dependent. We therefore classified our patients

**Table 1** Different concentrations of taste solutions

SWEET sucrose (gm/m)	SOUR citric acid (gm/ml)	SALTY sodium chloride (gm/ml)	BITTER quinine hydrochloride (gm/ml)	SCORE ALLOTTED
0.4	0.3	0.25	0.006	5
0.2	0.165	0.1	0.0024	4
0.1	0.09	0.04	0.0009	3
0.05	0.05	0.025	0.0004	2
0.01	0.01	0.005	0.0001	1

**Table 2** Comparison of mean taste scores

	Mean taste score	Standard deviation (SD)	Significance ( <i>p</i> value in comparison to pre-operative scores)
Pre-operative	12.35	2.61	
6 Weeks postoperative	10.67	3.02	<0.001
3 Months postoperative	9.96	2.82	<0.001

**Table 3** Mean taste scores in different age groups

Age	<i>n</i>	Preop taste scores		Taste scores at 6 weeks		Taste scores at 3 months		<i>p</i> value
		Mean	SD	Mean	SD	Mean	SD	
<20	10	12.4	2.2	8.8	1.1	8.4	1.2	<0.001
20–40	76	11.9	2.6	9.9	2.3	9.2	2.1	<0.001
>40	21	13.6	2.6	14.2	3.3	13.4	2.9	<0.001
Total	107	12.3	2.6	10.7	3.0	9.9	2.8	

**Table 4** Mean taste scores of patients in relation to duration of disease

Duration	<i>n</i>	Preop taste Scores		Taste scores at 6 weeks		Taste scores at 3 months		<i>p</i> value
		Mean	SD	Mean	SD	Mean	SD	
<2 Years	43	10.9	2.4	9.5	2.5	8.9	2.1	<0.001
2–5 Years	38	12.6	1.9	10.5	2.5	9.7	2.2	<0.001
>5 Years	25	14.5	2.2	12.9	3.4	12.4	3.3	<0.001
Total	106	12.3	2.6	10.7	3.0	9.9	2.8	

into three age groups consisting of (1) less than 20 years, (2) 20–40 years and (3) more than 40 years. In patients aged less than 40 years the taste function improved significantly postsurgery. However curiously, the mean pre-operative score of patients aged more than 40 years is 13.6 (Table 3), which remained at 14.2 at 6th postoperative week and 13.4 at 3 months postoperative period, suggesting that in elderly patients the recovery of taste function is likely difficult. Overall, the data suggest that younger patients fare better with respect to recovery in taste function post tympanoplasty.

#### Taste scores after tympanoplasty in relation to disease duration

In our study, 106 patients gave a history of ear discharge which suggested the approximate duration of illness for each patient. Patients were then classified into three groups (1) duration <2 years; (2) 2–5 years and (3) >5 years. Two conclusions could be drawn from this comparison. First, the taste threshold is progressively worse with increasing duration of disease and second, irrespective of duration of illness all groups show significant improvement in taste sensation post-tympanoplasty (Table 4).

#### Discussion

‘Tell me what you eat, and I will tell u who you are’: This popular quote by Jean Anthelme Brillat-Savarin demonstrates the importance of food and dietary preferences in a person’s life. Taste sensation gives valuable information about environmental dangers. For certain professionals like gourmet chefs and wine tasters the sense of taste is crucial. An impaired sense of taste will adversely affect a person’s dietary habits and in turn affect his quality of life.

During COM, dysfunction of Chorda Tympani nerve could happen as a result of exposure to toxins by the offending organism, due to inflammatory mediators triggered by the chronic inflammatory process or due to the immune response by the host. Histopathological examination of Chorda Tympani nerve in patients suffering from COM has shown various signs of nerve damage [6, 7]. A Swedish study published in 2015 noted that Chorda Tympani nerves in patients with COM showed a high rate of axon and myelin sheath degeneration. However, they also documented evidence which showed Chorda Tympani with axon sprouts suggesting that there was an ongoing regenerative process. This also suggested that there is potential for recovery of nerve function after

the offending factor is eliminated [8]. In cases of COM, Tympanoplasty removes exposure to external environment, infections and might hypothetically aid in the regenerative process.

In our study we investigated whether tympanoplasty would indeed influence nerve function recovery by assessing gustatory function pre- and post-tympanoplasty in patients suffering from COM (mucosal type). We used the three drop method where a pipette was used to deliver three drops of the taste solution. A possibility exists that the solution may diffuse across the midline and give rise to a potential bias which we have tried our best to avoid by repeated rinsing of mouth before and after each test with a taste solution. On comparing the preoperative and postoperative taste scores, we found a significant and steady improvement in taste scores at 6 weeks and 3 months after surgery ( $p$  value = 0.001). Similar findings were reported by a study done in Taiwan, China, where taste solutions of different concentrations were used to test the taste preoperatively, and postoperatively at durations of 2 days, 1 week, and 1 month. They report an improvement in taste function after tympanoplasty [5]. However, our result is not in agreement with a study done by Ciofalo and colleagues who did not observe any improvement in taste after surgery. Indeed, they observed a worsening of taste threshold in the postoperative period, which was more pronounced in patients undergoing stapedotomy [9]. One reason for the contradicting result may be due to the differences in study population. Unlike the study performed by Ciofalo and colleagues, our study does not include patients with otosclerosis and squamous type of COM. Although in this study we have not analyzed the change in subjective taste perception by the patients, we noticed during history taking that patients failed to report any alteration in taste. Ciofalo and colleagues analyzed alterations in the taste perception by patients using visual analog scale and reported no significant differences. This could be (1) Owing to the chronic nature of the disease, patients may not have noticed the gradual evolution of the impairment, hence would not have given much attention to subtle changes postsurgery (2) Taste is perceived as a whole mouth experience, and localized loss/improvement of taste function may not be appreciated by the patient.

In addition to evaluating taste function with recovery, we have also performed further analysis to link other confounding factors such as age, duration of disease, and presence of co-morbidities to the taste threshold in Indian cohorts. In our study, we observed that the mean taste score of patients aged more than 40 years was elevated in comparison to the total mean score. Similar results were noticed in a study conducted in Rio de Janeiro, which documented that age, longer duration of disease, and

diabetes mellitus have a negative impact on taste outcome [10]. Some and colleagues reported likewise that younger patients have better recovery of taste function [11]. It has been noted in various studies that with increasing age chances of nerve recovery decrease. In a study involving 250 patients of Bell's palsy it was seen that the rate of recovery for patients in their 20s was 83 %, which fell to 54 % for patients in 80s [12]. Younger patients demonstrate a significantly better improvement in taste function in comparison to the older patients. Similarly in median, ulnar, and radial nerve injuries, it has been observed that younger patients recover faster and better as compared to older patients [13].

Our results suggest that longer duration of disease has a detrimental effect on taste outcome. An Indian study involving 85 patients with unilateral COM concluded that, preoperative decrease in taste function is present on the diseased side [14]. This study contradicts our findings by stating that duration of the disease has no bearing on the taste function. Similar opinion was expressed by a study conducted in London in 1974, which noted an elevation in taste threshold using Electrogustometry on the diseased side, but concluded that age and duration of the disease do not influence the taste outcome in mucosal type of COM. Longer duration of disease was noted to have a deleterious effect on the taste outcome in our study. The mean taste score in patients with more than 5 years of COM was higher than the overall mean preoperatively, and remained elevated even after 3 months postoperatively. Felix and colleagues in their study noted likewise that duration of disease had an adverse impact on the taste outcome [10]. Various studies have come up with contradicting results with respect to duration of disease affecting taste recovery after tympanoplasty underlying the need for more comprehensive and controlled observations.

The difference in taste thresholds at 6 weeks and 3 months was evaluated using Chi-square test and  $p$  value was 0.37 and therefore noted to be insignificant. Correlation co-efficient was calculated and it was found that there is a significant moderate positive correlation ( $p = 0.001$ ) between taste score and duration. This implies that the difference in thresholds between 6 weeks and 3 months postoperative period, though not statistically significant in our cohort, might be significant over longer duration of recovery. Hence, patients who do not show an improvement in taste at 3 months should be on follow-up for a longer period, as it is likely that with time their taste function may improve. From the results of our study we are of the opinion that preoperative recording of taste would help us create awareness among the patients about the possible taste dysfunction due to the disease and inform about potential usefulness of surgery in the recovery of taste function.

## Conclusions

In patients with mucosal chronic otitis media, the taste perception improves over a period of time after adequate surgical clearance of the disease by Tympanoplasty. Pre-operatively, mean taste threshold is higher in patients aged more than 40 years and in patients with long duration of the disease. Recovery of taste function postoperatively is affected by factors such as age and duration of the disease. Older the age, poorer the recovery of taste function. Diseases of longer duration result in poorer taste function.

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### Compliance with ethical standards

**Conflict of interest** Authors declare no conflict of interest.

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