Original Article

Mucociliary Function Test of the Eustachian Tube and Its Correlation with Graft Uptake in Type I Tympanoplasty

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Abstract

Background: Eustachian tube (ET) also known as pharyngotympanic tube connects nasopharynx with the middle ear. Obstruction and abnormal patency are two types of Eustachian tube dysfunction (ETD) that have been suggested to predispose to otitis media. **Material and Methods:** In Fifty-three patients diagnosed with mucosal type chronic otitis media mucociliary function was assessed via saccharin test through the tympanic membrane defect. The time required for the patient to taste the saccharin (saccharin perception time- SPT) was measured. After a week of evaluation of mucociliary function type I Tympanoplasty was carried out in all cases. Outcome of type I Tympanoplasty was assessed on the basis of successful uptake of the graft. **Results:** There were 43.4% patients in 10-25 years followed by 39.6% patients in age group of 26-40 years. When correlation of outcome of tympanoplasty with mucociliary function test was done, it was statistically insignificant. **Conclusion:** Graft uptake did not correlate with mucociliary dysfunction. Thus, the outcome of tympanoplasty in terms of graft uptake is not significantly affected by mucociliary function of Eustachian tube.

Keywords: Chronic otitis media, Eustachian tube, Mucociliary clearance, Saccharin test, Tympanoplasty

Received: 10 July 2025 **Revised: 05 August 2025** **Accepted: 01 September 2025** **Published: 23 September 2025**

Introduction

Eustachian tube (ET) also known as pharyngotympanic tube connects nasopharynx with the middle ear. Functions of the Eustachian tube are pressure equalization and ventilation of the middle ear (ME), mucociliary clearance of secretions from the ME, protection of the ME from sounds, and from pathogens and secretions from the nasopharynx.[1] Obstruction and abnormal patency are two types of Eustachian tube dysfunction (ETD) that have been suggested to predispose to otitis media. Tubal obstruction may be either functional or mechanical.[2] Evaluation of the ET function is aimed in patients with chronic otitis media. A properly functioning ET is an integral part of a normally functioning middle ear and the existence of good tubotympanic mucociliary drainage constitutes a favorable prognostic factor in the outcome of tympanoplasty.[3]

Eustachian tube function can be measured by various methods like Valsalva's test, Toynbee test, Politzer's test, Eustachian tube catheterization. To assess the clearance and protective function of eustachian tube mucociliary clearance is tested using various materials like Fluorescein dye, Saccharin, Glucose and Methylene blue. Saccharin is a nonnutritive sweetner. It is inert to respiratory epithelium so does not hamper physiological mucus clearance of sino-nasal mucosa. The Saccharin test establishes both the anatomical and physiological patency of the ET.[4,5]

Thus, the present study has been undertaken to evaluate the mucociliary function test of ET (saccharin test) and its correlation with graft uptake in type I tympanoplasty.

Materials and Methods

It was anobservational prospective study and was carried out in the Department of Otorhinolaryngology from November 2019 to April 2021 at a tertiary care centre in India.

Fifty-three patients diagnosed with mucosal type chronic otitis media (tubotympanic type) presenting in the inactive stage, with no previous history of middle ear surgery on the test ear, and having medium sized or subtotal tympanic membrane perforation were included in the study. A detailed history and otorhinolaryngological examination was done and recorded in a

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DOI:
10.21276/amit.2025.v12.i3.82

How to cite this article: Sethi N, Sharma R, Sharma VK, Kumar A, Tiwari H. Mucociliary Function Test of the Eustachian Tube and Its Correlation with Graft Uptake in Type I Tympanoplasty. Acta Med Int. 2025;12(3):294-296.

preformed proforma in all the patients. Hearing threshold was tested clinically with tuning forks of 256 hz, 512 hz, 1024 hz. Hearing acuity was tested by pure tone audiometry in both the ears. All ears were mopped dry as far as possible. Mucociliary function was assessed in all the patients via saccharin test which was performed with the patient seated, under microscopic control, 1 scoop of micro curette of saccharin powder was placed in the middle ear, at the Eustachian tube opening, through the tympanic membrane defect. The time required for the patient to taste the saccharin (saccharin perception time- SPT) was measured.

- <20 min- normal SPT
- 20-45 min- partial dysfunction
- >45 min or no perception- gross dysfunction

Thus, all patients were categorized into 3 groups according to the mucociliary function test:

After a week of evaluation of mucociliary function type I Tympanoplasty was carried out in all cases, under local or general anesthesia through a post auricular approach by an underlay grafting technique. Follow up was performed after 6 and 12 weeks for otoscopic inspection of the operated ear.

Outcome of type I Tympanoplasty was assessed on the basis of successful uptake of the graft which was statistically correlated with mucociliary function of Eustachian tube.

Results

There were 43.4% patients in 10-25 years followed by 39.6% patients in age group of 26-40 years. The youngest patient was 13 years old and oldest was 68 years old. Mean age came out to be 29.72±12.14.

Table 1: Saccharin perception time (SPT) in patients

Saccharin perception time (min)	No of pts (n=53)	
	Number	%
<20	16	30.2%
20 – 45	33	62.3%
>45	4	7.5%

Mucociliary function of ET was assessed by using the saccharin powder and more than 70% had abnormal SPT and around 62% patients had SPT from 20-45 min [Table 1].

Table 2: Outcome of tympanoplasty (graft uptake) at 3rd, 6th and 12th week

Outcome	6th wk		12th wk	
	n (=53)	%	n (=53)	%
Healed	44	83.0%	44	83.0%
Healed & Retracted	6	11.3%	3	5.7%
Residual Perforation	3	5.7%	6	11.3%

Final outcome of tympanoplasty in terms of graft uptake was observed at 12 weeks where 83% patients had healed tympanic membrane and 5% patients had healed but retracted tympanic membrane. Residual perforation was seen in nearly 11% patients [Table 2].

Table 3: Correlation of the outcome of tympanoplasty with saccharin perception time

Saccharin Perception Time (Min)	Outcome of tympanoplasty (n=53)					
	6th wk			12th wk		
	Healed	Retracted	Reperforation	Healed	Retracted	Reperforation
<20	15 (28.3%)	0	1 (1.9%)	15 (28.3%)	0	1 (1.9%)
20 – 45	25 (47.2%)	6 (11.3%))	2 (3.8%)	26 (49.1%)	2 (3.8%)	5 (9.4%)
>45	4 (7.5%)	0	0	3 (5.7%)	1 (1.9%)	0
P value	0.348			0.275		

When correlation of outcome of tympanoplasty with mucociliary function test was done, it was statistically insignificant. Of all the patients having mucociliary function test dysfunction (SPT > 20 min), 86% patients had intact tympanic membrane at 12th week follow-up [Table 3].

Discussion

COM is the leading cause of conductive hearing impairment in both children and adults which is secondary to the damage of the eardrum and middle ear ossicles. A tympanic membrane (TM) perforation is any defect in the tympanic membrane resulting in exposure of the middle ear. TM perforation occurs as a result of CSOM which is one of the common causes of deafness in India and occupies a considerable amount of clinic and operating time of otorhinolaryngologists.[6,7]

Clinical experience as well as numerous patient studies and animal models prove that the ET plays an important role in various middle ear pathologies.[8-10] Despite improvements in the understanding of ET function, significant uncertainties remain due to its complex anatomy, multiple functions as well as the impact of intrinsic and external factors.[11,12]

In the present study, most patients had partial mucociliary dysfunction of ET with expected SPT more than 20 minutes (approximately 70% of patients). In comparison of our study on mucociliary function test to a study by Miki I et al,[18] most patients presented with partial mucociliary dysfunction of ET, however in another study by Prasad et al19 most patients had

normal mucociliary function (93.75%).

Outcome of type 1 tympanoplasty was assessed in terms of graft uptake and was evaluated at 6th and 12th week post operatively. Surgical success was defined as an intact graft after 3 months (12 weeks). In our study 88% patients had an intact graft at 3 months post operatively. Successful outcome of tympanoplasty in various studies were 78.7%,[15] 80.3%,[14] 82%,[13] 90%,[16] and 94.8%.[17]

Outcome of tympanoplasty was correlated with mucociliary function (Saccharin perception time). At 12th week follow-up 15.2% of patients having moderate mucociliary dysfunction developed residual perforation and 6.3% patients with normal mucociliary function had residual perforation. Though, less number of patients having normal mucociliary function developed residual perforation, outcome of tympanoplasty and mucociliary function were statistically insignificant. This was similar to the studies by Miki I et al,[18] and Ole E et al.[20] In a study by Mehtab A,[21] no significant correlation was present between mucociliary function and outcome of tympanoplasty. Although, Manning et al,[22] in his study reported that good mucociliary function is predictive of a good outcome of tympanoplasty.

Limitation of this study was that only mucociliary function was evaluated with respect to outcome of tympanoplasty and other factors like ET anatomy were not evaluated and moreover, the outcome of tympanoplasty can be multifactorial.

Conclusion

On the basis of saccharin perception time it was found that majority of the patients had partial mucociliary dysfunction. Despite of that, majority of the patients had healed tympanic membrane after tympanoplasty at 12th week follow-up. Thus, graft uptake did not correlate with mucociliary dysfunction (saccharin perception time). Thus, we concluded that the outcome of tympanoplasty in terms of graft uptake is not significantly affected by mucociliary function of Eustachian tube.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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