

“Exploring The Rhinotubal Relationship: Prospective Evaluation Of Eustachian Tube Function Before And After Endonasal Surgery”

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ABSTRACT

Background: Eustachian tube dysfunction (ETD) is commonly associated with sinonasal pathologies due to their close anatomical and functional relationship. “Conditions such as deviated nasal septum and chronic rhinosinusitis can impair Eustachian tube function, leading to middle ear pressure abnormalities and related symptoms. Endonasal surgical procedures aim to restore normal nasal airflow and may have a beneficial effect on Eustachian tube function.

Aim and Objectives: To comparatively evaluate Eustachian tube function preoperatively and postoperatively in patients undergoing endonasal surgeries using subjective and objective assessment tools.

Materials and Methods: This prospective cross-sectional observational study included 60 patients aged 18–60 years undergoing endonasal surgery. Preoperative and postoperative (day 45) assessment of Eustachian tube function was done using ETDQ-7 questionnaire, Valsalva maneuver, and tympanometry. Statistical analysis was performed to compare pre- and post-operative outcomes.

Results: The mean ETDQ-7 score significantly decreased from 14.77 ± 3.08 preoperatively to 9.27 ± 1.75 postoperatively ($p < 0.001$), indicating symptomatic improvement. Successful Valsalva maneuver increased from 10% to 26.7% postoperatively, reflecting improved functional patency. Tympanometry showed significant normalization of middle ear pressures, with mean improvement of approximately 43 daPa on the right side and 42 daPa on the left side ($p < 0.001$). Deviated nasal septum was the most common pathology observed.

Conclusion: Endonasal surgery leads to significant improvement in Eustachian tube function as demonstrated by subjective, functional, and objective parameters. Addressing sinonasal pathology plays a crucial role in restoring middle ear ventilation and improving patient outcomes”..

Keywords: Eustachian tube dysfunction, Endonasal surgery, ETDQ-7, Tympanometry, Valsalva maneuver, Deviated nasal septum, Middle ear pressure, Sinonasal pathology, Septoplasty, Functional endoscopic sinus surgery (FESS).

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INTRODUCTION

The Eustachian tube (ET) is a dynamic anatomical structure that plays a crucial role in maintaining middle ear homeostasis by regulating ventilation, pressure equalization, and clearance of middle ear secretions [1]. Proper functioning of the Eustachian tube ensures normal hearing and prevents middle ear pathologies such as otitis media with effusion, tympanic membrane retraction, and chronic suppurative otitis media. Dysfunction of the Eustachian tube can lead to significant morbidity and is often associated with various sinonasal conditions [2].

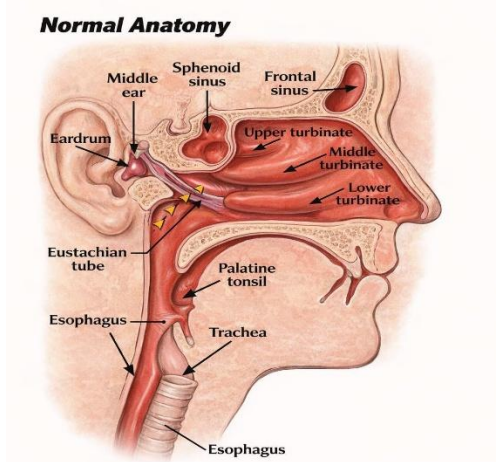


Fig 1: Anatomy of Ear

The nasal cavity, paranasal sinuses, and Eustachian tube share a close anatomical and physiological relationship. The Eustachian tube opens into the nasopharynx, and any pathology affecting the nasal cavity or nasopharynx, such as deviated nasal septum, nasal polyps, chronic rhinosinusitis, or adenoid hypertrophy, can influence its function [3]. Chronic inflammation and mucosal edema in the nasal and nasopharyngeal regions may impair Eustachian tube opening, leading to negative middle ear pressure and subsequent auditory complications [4].

Endonasal surgeries, including septoplasty, functional endoscopic sinus surgery (FESS), and polypectomy, are commonly performed procedures aimed at correcting sinonasal pathologies [5]. These surgeries not only improve nasal airflow and sinus drainage but may also have a beneficial impact on Eustachian tube function by reducing mucosal inflammation, relieving obstruction, and restoring normal nasopharyngeal dynamics. However, the effect of these surgical interventions on Eustachian tube function remains a subject of ongoing research, with studies reporting variable outcomes [6].

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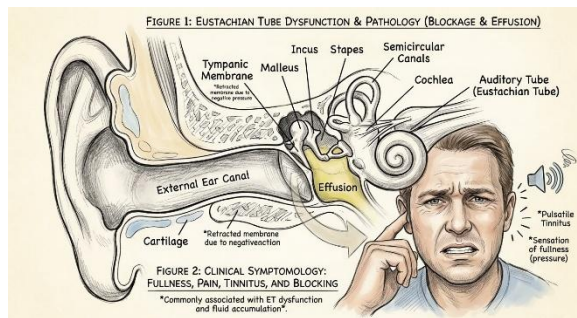


Fig 2: Eustachian Tube Dysfunction & Pathology

The Seven-Item Eustachian Tube Dysfunction Questionnaire.

Over the past 1 month, how much has each of the following been a problem for you?	No Problem			Moderate Problem			Severe Problem
1. Pressure in the ears?	1	2	3	4	5	6	7
2. Pain in the ears?	1	2	3	4	5	6	7
3. A feeling that your ears are clogged or "under water"?	1	2	3	4	5	6	7
4. Ear symptoms when you have a cold or sinusitis?	1	2	3	4	5	6	7
5. Cracking or popping sounds in the ears?	1	2	3	4	5	6	7
6. Ringing in the ears?	1	2	3	4	5	6	7
7. A feeling that your hearing is muffled?	1	2	3	4	5	6	7

Fig 3: Eustachian Tube Dysfunction Questionnaire

Assessment of Eustachian tube function can be performed using both subjective and objective methods. The Eustachian Tube Dysfunction Questionnaire (ETDQ-7) is a validated tool used to assess patient-reported symptoms related to Eustachian tube dysfunction [7]. Objective evaluation methods such as tympanometry provide information about middle ear pressure and compliance, while clinical tests like the Valsalva maneuver assess the functional patency of the tube. Combining these methods allows for a comprehensive evaluation of both symptomatic and physiological aspects of Eustachian tube function [8].

Understanding the impact of endonasal surgeries on Eustachian tube function is clinically significant, as it may influence postoperative outcomes, patient satisfaction, and overall quality of life [9]. Improvement in Eustachian tube function following surgery could reduce the incidence of middle ear complications and improve auditory function". Conversely, lack of improvement or deterioration may necessitate further evaluation and management [10]. Despite the recognized association between sinonasal disease and Eustachian tube dysfunction, there is limited prospective data evaluating changes in Eustachian tube function before and after endonasal surgical interventions, particularly in the Indian population [11]. Hence, this study was undertaken to comparatively evaluate Eustachian tube function in patients undergoing endonasal surgeries in the preoperative and postoperative periods using both subjective and objective assessment tools.

AIMS AND OBJECTIVES

Aim: A comparative evaluation of Eustachian Tube Function preoperatively and postoperatively in patients

undergoing endonasal surgeries.

Objectives: To assess functions of Eustachian Tube in patients undergoing Endonasal Surgery in pre- and post-operative period.

MATERIALS AND METHODS

The present study was designed as a prospective cross-sectional observational study conducted over a period of one year from 16th April 2024 to 15th April 2025 in the Department of Otorhinolaryngology and Head & Neck Surgery (ENT & HNS) at Dr. Prabhakar Kore Charitable Hospital, Belagavi, a tertiary care teaching hospital. "The study population comprised 60 patients aged between 18 and 60 years who were planned to undergo endonasal surgical procedures and attended the ENT outpatient department during the study period. Patients presenting with sinonasal complaints and advised surgical intervention after detailed clinical evaluation were included. Patients with a non-intact tympanic membrane, previous history of endonasal surgery, bleeding disorders, or craniofacial abnormalities were excluded from the study.

All eligible patients were enrolled prospectively after obtaining informed consent. A detailed clinical history and thorough ENT examination were performed for each patient. Preoperative assessment of Eustachian tube function was carried out using both subjective and objective methods. The Eustachian Tube Dysfunction Questionnaire-7 (ETDQ-7) was administered to evaluate patient-reported symptoms. Objective evaluation included tympanometry to assess middle ear pressure and compliance, along with the Valsalva maneuver to assess functional patency of the Eustachian tube.

All patients subsequently underwent the indicated endonasal surgical procedure as per standard institutional protocols. Postoperative evaluation was performed at 45 days following surgery. At this follow-up, patients were reassessed using the same parameters, including ETDQ-7 scoring, Valsalva maneuver, and tympanometry". The preoperative and postoperative findings were compared to evaluate changes in Eustachian tube function following endonasal surgery. Data collected were recorded systematically and subjected to appropriate statistical analysis to determine the significance of observed changes.

RESULTS

Table 1: Comparison of ETDQ-7 scores Preoperatively and Postoperatively (n=60)

Parameter	Pre-operative (Mean $\pm$ SD)	Post-operative (Mean $\pm$ SD)	Mean Difference	t-value	p-value
ETDQ-7 score	14.77 $\pm$ 3.08	9.27 $\pm$ 1.75	5.50	16.38	<0.001

There was a significant reduction in mean ETDQ-7

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score postoperatively, indicating marked improvement in patient-reported symptoms of Eustachian tube dysfunction. “The change was statistically highly significant ($p < 0.001$), suggesting a strong positive impact of endonasal surgery on ET function. This reflects effective symptomatic relief following surgical intervention.

Table 2: Comparison of Valsalva Maneuver Outcomes Pre- and Post-operatively (n=60)

Outcome	Pre-operative n (%)	Post-operative n (%)	p-value
Successful	6 (10.0%)	16 (26.7%)	<0.05
Not Successful	54 (90.0%)	44 (73.3%)	

The proportion of patients with successful Valsalva maneuver increased from 10% preoperatively to 26.7% postoperatively. This indicates improved functional patency of the Eustachian tube following surgery. The improvement suggests enhanced ability to equalize middle ear pressure after correction of sinonasal pathology.

Table 3: Comparison of Tympanometric Findings Pre- and Post-operatively (n=60)

Side	Pre-op Mean $\pm$ SD (daPa)	Post-op Mean $\pm$ SD (daPa)	Mean Change	t-value	p-value
Right Ear	-61.45 $\pm$ 20.68	-18.36 $\pm$ 22.35	43.09	47.846	<0.001
Left Ear	-60.40 $\pm$ 20.96	-18.15 $\pm$ 23.41	42.25	41.388	<0.001

Preoperative tympanometry showed significantly negative middle ear pressures, which improved markedly postoperatively towards near-normal values. The changes were statistically highly significant ($p < 0.001$) on both sides. This demonstrates objective improvement in middle ear ventilation and Eustachian tube function following surgery.

Table 4: Overall Improvement in Eustachian Tube Function

Parameter	Indicator of Improvement	Result
ETDQ-7	Reduction in symptom score	Significant improvement
Valsalva	Increase in successful cases	Improved

Tympanometry	Shift towards normal pressure	Significant improvement
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All three assessment modalities consistently demonstrated improvement in Eustachian tube function postoperatively. Both subjective and objective parameters showed concordant results, strengthening the validity of findings. This confirms that endonasal surgery positively influences ET function across multiple domains.

Table 5: Percentage Improvement in Eustachian Tube Function Parameters

Parameter	% Improvement
ETDQ-7 score	37.24%
Tympanometry (Right)	70.12%
Tympanometry (Left)	69.95%
Valsalva Success Rate	Increased from 10% $\rightarrow$ 26.7%

A substantial percentage improvement was observed across all parameters, with the highest improvement noted in tympanometric values. ETDQ-7 scores also showed considerable symptomatic improvement, while Valsalva success rates increased significantly”. These findings collectively highlight the clinical effectiveness of endonasal surgery in improving Eustachian tube function.

DISCUSSION

Eustachian tube dysfunction (ETD) is a well-recognized consequence of sinonasal pathology, arising due to impaired nasal airflow, mucosal inflammation, and compromised nasopharyngeal ventilation. “The present study was undertaken to evaluate changes in Eustachian tube function following endonasal surgeries using both subjective and objective assessment tools. The findings demonstrated significant postoperative improvement across all parameters, thereby reinforcing the functional interdependence between the nasal cavity, paranasal sinuses, and middle ear ventilation.

The demographic profile of the study population revealed a predominance of patients in the 21–40 years age group, with a mean age of 33.2 ± 12.2 years. Similar age distribution has been reported by Khalafalla et al. (2019) and Youssef et al. (2020), who noted higher prevalence of sinonasal disease in younger adults due to increased environmental exposure and recurrent upper respiratory infections [12,13]. A male predominance (60%) was observed, consistent with findings by Kaya et al. (2018) and Elsoud et al. (2021), possibly reflecting occupational exposure and healthcare-seeking patterns [14,15].

Deviated nasal septum (DNS) was identified as the most common sinonasal pathology, either alone or in

combination with other conditions. This aligns with studies by Nanda et al. (2017) and Kaya et al. (2018), which established DNS as a major contributor to impaired nasal airflow and ET dysfunction [14,16]. The improvement in Eustachian tube function observed in the present study can be attributed to restoration of nasal airflow and reduction in mucosal edema following surgical correction.

Subjective assessment using the ETDQ-7 questionnaire showed a significant reduction in mean scores from 14.77 ± 3.08 preoperatively to 9.27 ± 1.75 postoperatively, indicating a 37.24% improvement. These findings are in agreement with Chang et al. (2019) and Wu et al. (2020), who reported significant postoperative reductions in ETDQ-7 scores following endoscopic sinus surgery [17,18]. Similarly, Vijayan et al. (2021) demonstrated marked symptomatic improvement after septoplasty and FESS, highlighting the sensitivity of ETDQ-7 in detecting clinical changes [19].

Functional assessment using the Valsalva maneuver revealed an increase in successful outcomes from 10% preoperatively to 26.7% postoperatively, indicating improved Eustachian tube patency. Comparable improvements have been reported by Choi et al. (2017) and Youssef et al. (2020), suggesting that surgical correction enhances the active opening mechanism of the Eustachian tube [9,13]. However, as noted in previous studies, the Valsalva maneuver is effort-dependent and should be interpreted alongside objective measures.

Objective evaluation using tympanometry demonstrated marked bilateral improvement in middle ear pressures, with mean values improving from -61.45 ± 20.68 daPa to -18.36 ± 22.35 daPa on the right side and from -60.40 ± 20.96 daPa to -18.15 ± 23.41 daPa on the left side. These changes were statistically highly significant ($p < 0.001$). Similar findings have been reported by Kaya et al. (2018) and Rathaur and Verma (2016), who observed normalization of tympanometric values following septoplasty [14,20]. Khalafalla et al. (2019) also reported a shift towards Type A tympanograms postoperatively, indicating improved middle ear ventilation [12].

Overall, the present study demonstrated concordant improvement in subjective symptoms, functional patency, and objective middle ear parameters following endonasal surgery. These findings strongly support the role of surgical correction of sinonasal pathology in improving Eustachian tube function. The consistency of results across multiple assessment modalities enhances the reliability of the study and underscores the importance of integrated evaluation in patients with ETD.

CONCLUSION

The present study demonstrates that endonasal surgical interventions significantly improve Eustachian tube

function in patients with sinonasal pathology. “A marked reduction in ETDQ-7 scores indicates substantial symptomatic relief, while improvement in Valsalva maneuver success reflects enhanced functional patency of the Eustachian tube. Additionally, tympanometric findings showed significant normalization of middle ear pressures bilaterally, confirming objective improvement in middle ear ventilation.

Deviated nasal septum emerged as the most common underlying pathology, and its correction played a key role in restoring normal nasal airflow and Eustachian tube dynamics. The concordance between subjective, functional, and objective assessment tools strengthens the validity of these findings.

Overall, endonasal surgery not only alleviates sinonasal symptoms but also has a beneficial impact on Eustachian tube physiology. These findings highlight the importance of evaluating and addressing sinonasal pathology in patients with Eustachian tube dysfunction for optimal clinical outcomes..

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