

Effect of Endoscopic Sinus Surgery on Eustachian Tube Dysfunction in Chronic Rhinosinusitis

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ABSTRACT

Objective: To assess the effectiveness of endoscopic sinus surgery (ESS) on symptoms of Eustachian Tube Dysfunction (ETD) in adult patients with chronic rhinosinusitis (CRS).

Study Design: Quasi-experimental study

Place and Duration of Study: Department of ENT, Combined Military Hospital, Rawalpindi, Pakistan, from Dec to Jan 2022.

Methodology: The effect of ESS on ETD of 82 patients was evaluated by analyzing retrospective data from the Sino-Nasal Outcome Test (SNOT-22) and Eustachian Tube Dysfunction Questionnaire 7 (ETDQ-7) assessments in adult CRS patients who underwent ESS.

Results: The median (IQR) ETDQ-7 score was 16.0(5), with 50 patients demonstrating clinically significant ETD indications with an ETD-Q score of 15.0 and above. On the other hand, the median (IQR) SNOT-22 score was 45.0(14). The Spearman's correlation coefficient value of 0.24 ($p=0.031$) indicated a significant relationship between ETDQ-7 and the total SNOT-22 score.

Conclusion: These results suggest that the E-tube performance of adult CRS patients improves considerably after ESS, and it should be implemented for the management of CRS in adult patients with Eustachian tube dysfunction.

Keywords: Chronic Rhinosinusitis, Eustachian Tube Dysfunction Questionnaire, and Endoscopic Sinus Surgery.

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INTRODUCTION

The nasal cavity and paranasal sinuses are located next to each other and linked to the middle ear through the Eustachian tube (ET).¹ The ET performs physiological activities such as pressure normalization, protection, and drainage of the middle ear.² As a consequence, illnesses in both locations may interact, and it is not uncommon in clinical practice to find patients who have issues with both their nose and their ears. Chronic rhinosinusitis (CRS) is one of the prevalent chronic health conditions affecting approximately 16% of the adult population.³ It is described as an inflammatory condition with nasal blockage, olfactory dysfunction, facial pain, and nasal discharge that lasts for at least 12 weeks.⁴ Chronic rhinosinusitis may produce swelling in the region of the E-tube opening, resulting in ET dysfunction and, as a consequence, middle ear illness.⁵ Impaired hearing, discomfort, vertigo, a sense of pressure in the ear or disequilibrium may develop as a consequence of ETD.⁶

Surgery is generally used as an adjuvant to medical treatment.⁷ Endoscopic sinus surgery (ESS)

has undergone significant advancements in technology and surgical technique since its inception. The primary objectives of ESS in managing sinusitis include enlarging the sinus ostia to facilitate adequate drainage, restoring optimal sinus aeration, enhancing mucociliary clearance, and establishing an effective conduit for topical medications to reach the disease-affected sinus mucosa. ESS has become the gold standard treatment modality for patients with medically refractory chronic rhinosinusitis (CRS), with or without associated Eustachian tube dysfunction (ETD). These technological and procedural innovations have led to improved surgical precision, reduced patient morbidity, shorter recovery times, and better overall treatment outcomes.⁸

By critically appraising the available literature, assessing clinical outcomes, and utilizing objective measures, this study aims to generate evidence regarding the potential benefits and limitations of endoscopic sinus surgery (ESS) in improving Eustachian tube function and patient quality of life. Such an investigation may not only refine surgical strategies but also advance the understanding of the complex relationship between chronic rhinosinusitis, sinonasal pathology, and middle ear physiology. This study seeks to evaluate the impact of ESS on

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Eustachian tube dysfunction within the context of chronic rhinosinusitis.

METHODOLOGY

The quasi-experimental study was conducted from Dec to Jan 2022, in the ENT department of the Combined Military Hospital (CMH), Rawalpindi, Pakistan. After receiving clearance from the hospital board of ethics (IRB CMH Rawalpindi number 246/02/2022). The retrospective data, used to determine cases with ETD, allowed the researcher to employ a convenience sampling approach in a sequential order. Hence, the consecutive sampling technique was used to find pre-diagnosed ETD patients. Sample size was calculated by using the "Effect Size technique" with a mean difference of 7.8, $\alpha=0.05$, and $ES=0.376$. A sample of 90 was determined for the study. Informed written consent was taken. Six patients who declined to participate and two patients who failed to follow up were removed from the study. (Figure-1). Demographic variables like age and gender of 82 patients were collected through written forms submitted by the patients.

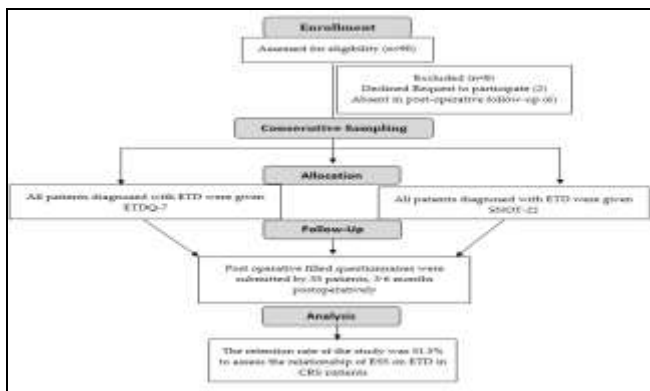


Figure-1: Patient Flow Diagram for Retrospective Study of ESS Impact on ETD in CRS Patients

Inclusion Criteria: Patients of both male and female genders, ranging between 30 and 60 years of age, having CRS over the age of 20 who had undergone ESS were recruited retrospectively from electronic medical records.

Exclusion Criteria: Patients with other otologic conditions, such as otitis media, hearing loss, or tinnitus, were excluded from our study to prevent their effects from interfering with the study's results. Additionally, six patients who declined to participate were not the study subjects.

After ESS, these patients were given questionnaires to fill out and submit back to the hospital. From the complete medical history and follow-up records of 82 patients, SNOT-22 and ETDQ-7 examination outcomes were analyzed. The Sino-Nasal Outcome Test-22 (SNOT-22) is a validated patient-reported outcome measure consisting of 22 items designed to evaluate the symptom burden and health-related quality of life in patients with chronic rhinosinusitis. It covers physical symptoms (nasal obstruction, facial pain), ear and facial discomfort, sleep function, and psychological effects (fatigue, sadness), providing a comprehensive assessment of the disease's impact on daily living and well-being.⁷ The outcomes defining ETD were assessed from ETDQ-7 medical examinations. The Eustachian Tube Dysfunction Questionnaire (ETDQ-7) consists of the following 7 symptom-based items, each rated on a scale from 1 (No Problem) to 7 (Severe Problem) based on how much each symptom has been a problem over the past month. (Pressure in the ears, Pain in the ears, A feeling that your ears are clogged or "underwater", Ear symptoms when you have a cold or sinusitis, Crackling or popping sounds in the ears, Ringing in the ears, A feeling that your hearing is muffled.) These items provide a symptom-specific assessment to quantify the burden of Eustachian tube dysfunction symptoms in patients.²⁰

The data analyzed was tabulated as means for continuous variables and medians for discrete variables. The categorical variables were expressed as percentages. The Spearman correlation coefficients was used to find out the relationship between ETDQ 7 and SNOT 22 Scores. The p -value ≤ 0.05 was regarded as statistically significant.

RESULTS

Eighty-two patients with CRS participated in this study group. Among them, 36(44.0%) were males, and 27(29.7 %) were female patients. The mean age of male patients was 44.94 ± 5.90 years, and that of female patients was 45.87 ± 6.20 years.

Table-I displays the overall SNOT-22 score as well as the subdomain scores for each domain. The overall group's median (IQR) ETDQ-7 score calculated was 16.0(5.0). Questions 3 and 4, which reflected aural fullness plus the ear difficulties linked with sinusitis or cold, respectively, were the most often answered correctly by the cohort. As a consequence, the median (IQR) total SNOT-22 score calculated was 45.00.¹⁴

Figure-2 shows the coefficients of association between ETDQ-7 scores and those obtained by conducting the SNOT-22 test. The ETDQ-7 and SNOT-22 exhibited a strong relationship, with a Spearman correlation coefficient value of 0.24 (p -value=0.031), indicating a significant relationship.

Thirty-three patients returned their postoperative questionnaires between three and six months after surgery, resulting in a 51.5 percent retention rate in this research. The median preoperative ETDQ-7 score is 16.0(5.0).

Table-I: Descriptive Statistics for Patient-Reported Eustachian Tube Dysfunction Symptoms using SNOT-22 (Sino-Nasal Outcome Test) (n=82)

Questions	Median	IQR
Pressure in the ears?	2.0	2.0
Pain in the ears?	2.0	1.0
A feeling that your ears are clogged or "under water"?	2.0	2.0
Ear problems when you have a cold or sinusitis underwater	2.0	2.0
Ringing in the ears?	2.0	1.0
Crackling or popping sounds in the ear?	2.0	2.0
A feeling that your hearing is muffled?	2.0	2.0

*IQR = Interquartile Range

Table-II: Statistical Analysis from the Data

Variable	Median	IQR
Total SNOT22	45.0	14.0
Rhino logic	13.0	7.0
Extra-nasal Rhino logic	5.0	3.0
Ear Facial	7.0	4.0
Psychologic	10.5	7.0
Sleep	8.5	7.0
Total ETDQ7	16.0	5.0

*IQR = Interquartile Range

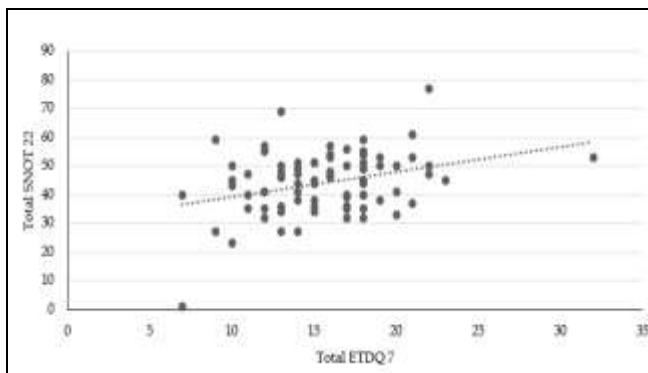


Figure-2: Relationship Between ETDQ 7 and SNOT 22 Scores

DISCUSSION

The findings of the current correlational study indicate that 61% of chronic rhinosinusitis (CRS) patients scored 15.0 or higher on the ETDQ-7, signifying clinically significant Eustachian tube

dysfunction (ETD). Patients unresponsive to medical treatment who proceeded to surgery represent a more severe CRS subset.⁹ The average SNOT-22 score was 44.2, reflecting a substantial symptom burden. While past studies have reported ear-related complaints such as ear pain, popping, and pressure/fullness in CRS patients,¹⁰ those studies lacked a validated patient-reported outcome measure, which this study addresses using ETDQ-7 and SNOT-22 scales.¹¹ Overall, these findings provide validated, quantitative insight into the comorbid ETD in CRS and highlight the decrease in severity of symptoms in surgically managed patients, yet making it a preferable treatment modality.¹²

In recent years, Tangbumrungham *et al.*, have examined the ETD symptoms with the help of the ETDQ-7 instrument in the population of CRS patients. 48.5 percent of CRS patients who reported to the Stanford Sinus Center experienced the symptoms of ETD that were clinically significant, with an ETDQ-7 score of 14.5.¹³ However, it was also examined in a tertiary center during these appointments. The average SNOT-22 score is reported as lower than indicated in this study. Similar high rates of ETD symptoms, with 43.3 % were identified by Marino *et al.*, in individuals with an average SNOT-22 score of 34.5.¹⁴

More than two-thirds of the participants studied by Bowles *et al.*, had ETD symptoms and found a high incidence of concurrent ETD symptoms in patients with severe CRS, which were improved following ESS.¹⁵ According to a recent study by Higgins *et al.*, which studied a group of just surgical CRS patients and found that 46% of them had clinically meaningful ETD symptoms before surgery.¹⁶

The overall prevalence of ETD with clinically meaningful ETD symptoms is rather consistent in the literature, despite the wide range of demographics and methodologies used. A total of both ETDQ-7 scores and SNOT-22 scores was shown to be clinically significant in this study, determining a strong relationship between the ETDQ-7 and the total SNOT-22. Chang *et al.*, reported that ETD symptoms often improve following ESS. The author also highlighted the factors associated with improvement, including higher preoperative disease burden, posterior ethmoidectomy, and postoperative corticosteroid spray.¹⁷ SNOT-22 scores and Ear/Facial subdomain scores closely correspond with ETD symptoms in CRS patients, as shown by Chen *et al.*¹⁸

The absence of a control group in this study may have allowed a substantial placebo effect to influence the post-surgery outcomes. Additionally, the high dropout rate of 49% in the post-surgery surveys could have affected the reliability of the results. It is also important to note that the ETDQ-7 score was used only to assess symptoms related to Eustachian Tube Dysfunction (ETD) and did not confirm an actual ETD diagnosis. Objective indicators of ETD, such as preoperative tympanometry and other tympanic measurements, were not evaluated in this study.

Temporomandibular joint dysfunction (TMJD) is the most common comorbid disease to cause similar otological symptoms.¹⁹ TMJD patients' mean ETDQ-7 score was 24.5±12.5, with two-thirds of patients having an ETDQ-7 score of more than 14.5±11. ETDQ-7 alone may not be enough to diagnose ETD, which is a major confounding factor in this study and most of the literature. When assessing the remission of otological symptoms after FESS, Dr. Higgins' study suggests that TMJD may be an important confounding factor.^{16,20} There are no other reliably recorded objective measures of ETD other than those made by Bowles et al (tympanometry and Valsalva).¹⁵ The ETDQ-7, on the other hand, is a useful tool for keeping track of the onset or disappearance of symptoms.^{21,22} ETD in CRS patients should be assessed using an objective measure of ETD in addition to the ETDQ-7 in future studies.

CONCLUSION

ESS was found to significantly improve Eustachian tube function in patients with CRS, as evidenced by both subjective and objective measures. Patients with CRS frequently exhibit ETD symptoms, and these are positively influenced by surgical intervention. Strong correlations were observed between ETDQ-7 and the Ear/Facial subdomain of SNOT-22, highlighting the interrelationship between sinonasal and otologic symptoms. ESS should therefore be considered not only for refractory CRS but also in patients with concomitant ear discomfort, as improvement in ET function may be achieved. Integration of ETD assessment into CRS evaluation is recommended for comprehensive management.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

IY & AH: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

KZM & AAS: Data acquisition, data analysis, approval of the final version to be published.

FM & SH: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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