



Original

Endoscopic Evaluation of Pharyngeal End of Eustachian Tube and Eustachian Tube Dysfunction Symptoms Score Among Adult Patients

¹Adekunle Adeyemo, ²Samuel O. Ayodele, ²Ogochukwu C. Ejiofor, ²Sunday C. Uhalla

¹Department of Otorhinolaryngology, College of Health Sciences, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

²Otorhinolaryngology Department, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Osun State, Nigeria

Corresponding author: Samuel Oluyomi Ayodele, Department of Otorhinolaryngology, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Osun State, Nigeria. oluayo4me8659@gmail.com; +2347065946866

Article history: Received 02 April 2025, Reviewed 17 May 2025, Accepted for publication 02 June 2025

Abstract

Background: Eustachian tube dysfunction is central to Otitis Media with Effusion which may occur because of poor ET functions. Nasal endoscopy gives a direct visualization of the pharyngeal orifice of the ET and has the ability to establish, diagnose and assess various pathological causes of ETD. This study addressed gap in knowledge by determining the symptoms scores, endoscopic grading of ET and tympanometric findings among participants.

Methodology: This is a hospital based cross-sectional study. Written informed consent was taken and a study proforma was used to record information from the assessment of recruited individuals. Clinical assessment, Eustachian Tube Dysfunction Questionnaire, ENT examination, tympanometry and nasal endoscopy were carried out. The two grading systems (mucosal inflammatory endoscopic grading and the 3ET endoscopic assessment of the pharyngeal end of the ET) was used to assess the pharyngeal end of the ET orifice. The data collected was analyzed and depicted using prose, tables, and chart.

Results: A total of 54 participants with male to female ratio of 1:1.8 and mean age of 49.98 years \pm 19.179. ETDQ-7 was abnormal in 28 (51.9%) of participants. There was a statistically significant difference between ETDQ-7 and tympanometry results. Thirty-five (64.8%) participants were diagnosed with Otitis Media with Effusion while others had Chronic Rhinosinusitis. The relationship between endoscopic grading and tympanometry report was statistically significant.

Conclusion: Combination of the ETDQ-7 scores, endoscopic grading and tympanometry will give a more reliable report of the ET status among patients with OME and CRS.

Keywords: Eustachian tube dysfunction; Tympanometry; Mucosal inflammatory grading system; Endoscopic assessment of the pharyngeal end; Otitis Media with Effusion.



This is an open access journal and articles are distributed under the terms of the Creative Commons Attribution License (Attribution, Non-Commercial, ShareAlike" 4.0) - (CC BY-NC-SA 4.0) that allows others to share the work with an acknowledgement of the work's authorship and initial publication in this journal.

How to cite this article

Adeyemo A, Ayodele SO, Ejiofor OC, Uhalla SC. Endoscopic Evaluation of Pharyngeal End of Eustachian Tube and Eustachian Tube Dysfunction Symptoms Score Among Adult Patients. The Nigerian Health Journal 2025; 25(2): 707 – 715.
<https://doi.org/10.71637/tnhj.v25i2.1071>



Introduction

Eustachian tube dysfunction (ETD) is a constellation of signs and symptoms suggestive of a malfunctioning Eustachian tube (ET).¹ The ET has three primary functions: middle ear pressure equalization and ventilation, mucociliary clearance of secretions from the middle ear and protection of the middle ear from sounds as well as from pathogens and secretions from the nasopharynx.^{1,2} Swallowing, yawning and sneezing are certain conditions that open the nasopharyngeal end of the tube thereby performing the above stated functions. Impairments of these functions lead to ETD which manifest as impairment of pressure regulation, loss of protective function and impairment of clearance.³ In a British study, the prevalence of ETD among adult patients was 0.9%.⁴ Hospital visits in relation to ETD in America exceeded 2 million per annum with more females affected. The study also noted a prevalence of 20% of ipsilateral otitis media with effusion (OME) with ETD among patients with nasopharyngeal tumor.⁵ The overall prevalence of ETD in Africa is 6%.⁶

ETD can be classified into three: baro-challenge-induced, patulous and dilatory types. Dilatory ETD is further divided into functional obstruction, dynamic dysfunction (muscular failure) and anatomical obstruction.^{1,7,8} The resultant dysfunction of the ET is central to the pathogenesis of various middle ear pathologies like otitis media with effusion.³ The main etiological factor is the alteration in mucociliary system of middle ear due to the malfunctioning state of the ET.⁹ Diseases of the sinonasal region may affect the functions of the ET and consequently that of the middle ear because these structures are closely related anatomically and share common features.¹⁰ CRS is characterized by mucopurulent discharge leading to changes in the mucosal lining of the pharyngeal end of ET. This can result in mucosa edema and inflammation of subepithelial lymphoreticular network leading to the impairment and obstruction of the ET orifice.¹¹ The subsequent clinical symptoms of ET dysfunction include impaired hearing, otalgia, tinnitus, reduced hearing, feeling of fullness in the ear or problems with balance, aural fullness or pressure, a sensation of clogged or muffled hearing, and feature of a retracted or poorly mobile tympanic membrane on pneumatic otoscopy.^{12,13} Tympanometry is an objective, non-invasive, physiological measure of acoustic immittance of the middle ear as a function of air pressure in a sealed ear canal. It measures how the middle ear system responds

to sound energy and how it reacts dynamically to changes in the atmospheric pressure.¹⁴

Tympanometry establishes the ET function indirectly by measuring the middle ear pressure but can miss subtle anatomical abnormalities that cause functional deficit which can be revealed by endoscopic evaluation of the ET.^{15,16} The “7-item Eustachian Tube Dysfunction Questionnaire” (ETDQ-7) described and validated by McCoul et al¹⁷ has been used subjectively to assess ETD with findings comparable to endoscopic assessment. The ETDQ-7 is made up of 7 items, with each question being rated on a scale of 1 to 7. Total scores range from 7 to 49, and a total item score cut point of ≥ 14.5 indicates the presence of Eustachian tube dysfunction¹⁸ The endoscopic ET inflammatory rating scale is used for clinical evaluation of the severity of inflammatory changes in the mucosa within the nasopharyngeal orifice and lumen of the ET.⁷ It has the ability to establish, diagnose and assess various pathological causes of ETD.⁸ Many researchers have devised various endoscopic grading for assessment of ET orifices with various drawbacks and therefore none is considered the gold standard for the diagnosis of ETD.¹⁶

In all, many of these subjective and objective methods of assessing the ET function have provided valuable information regarding the structural and functional status of the ET. But there is still limited publications on the use of the endoscopic assisted Eustachian tubal mucosal inflammation grading and ETDQ-7 in determining the severity of the ETD among patients in Low-Middle-Income Countries (LMICs) of Africa. This study therefore seeks to address the gap in knowledge by determining the endoscopic grading of ET mucosal inflammation. The findings will be further correlated with tympanometric findings and ETDQ-7 among participants in our hospital unit.

Methodology

This was a hospital based cross-sectional study which entails adults with clinical features suggestive of Otitis Media with Effusion or Chronic Rhinosinusitis. Convenience sampling technique was employed in this study to recruit all consecutive consenting adult patients who present to the Otorhinolaryngology Clinic and satisfy the inclusion criteria within the period of the study. The estimated minimum sample size was determined by using the Leslie Kish's formula¹⁹ to arrive

at a minimum sample size of 54 participants. Ethical approval was obtained from the Ethics & Research Committee (ERC) of the Hospital before the research was carried out.

A detailed explanation of the purpose of the study and the procedures involved was done. A written informed consent was obtained and study proforma administered to each consenting participant that were recruited. Clinical assessment was carried out on all participants. This included history taking, administration of the Eustachian tube dysfunction questionnaire (ETDQ-7), Ear, Nose and Throat (ENT) examination, tympanometry and nasal endoscopy. Two grading systems (the four-point mucosal inflammatory grading system and the 3ET endoscopic assessment of the pharyngeal end of the ET) was used to assess the pharyngeal end of the ET orifice. Findings on the assessment were documented appropriately in the proforma. Tympanometry results were further classified into Type A for normal middle ear functions and Type B and C for middle ear dysfunctions related to Eustachian Tube Dysfunctions. The data collection was carried out within a 15-month period and the data collected was entered into the Statistical Product and Service Solutions (SPSS) version 24. The data entered was sorted and checked for possibilities of errors during entry. The results were summarized and presented as quantitative and qualitative variables, which was depicted using tables and figures. Quantitative variables were expressed as mean and standard deviation (SD). Qualitative variables were expressed as frequencies and percentages; and Chi squared test was used to establish association between the qualitative variables. The association between continuous variables and specific outcome variables was tested using student t-test or analysis of variance (ANOVA), where the assumptions are met. For all statistical studies, p -value ≤ 0.05 was considered as being statistically significant.

Results

A total of fifty-four (54) participants with nineteen (19) male and thirty-five (35) female with a male to female ratio of 1:1.8 (Figure 1). The age range of participants was between 18 and 92 years with a mean age of 49.98 years \pm 19.179. The mean ETDQ-7 score was 16.22 \pm 7.60. ETDQ-7 was said to be abnormal (≥ 14.5 points) in 28 (51.9%) of the participants. Reports of tympanometry showed that 31 (57.4) participants had

Type A, while 6 (11.1%), 16 (29.6%) and 1 (1.9%) had Type B, Type C, and Type As respectively. Table 1 revealed the relationship between ETDQ-7 and the There was a statistically significant difference (p value = 0.0098) between the two groups. Thirty-five (64.8%) participants were diagnosed with Otitis Media with Effusion while others (35.2%) had Chronic Rhinosinusitis. The four-point mucosal inflammatory grading system was used to grade participants into Grade I to IV. Based on the diagnosis, the highest number of participants (40.0%) who were diagnosed of OME had Grade II while the highest number of participants (47.4%) who were diagnosed of CRS had Grade I.

On table 2, the associations between four-point mucosal inflammatory endoscopic grading and each of the tympanometry results, ETDQ-7 scores and diagnosis of participants were expressed. There was a statistically significant difference (p value = 0.0076) between the endoscopic grading and tympanometry reports. However, there was no statistically significant association between endoscopic grading and ETDQ-7 as well as with the clinical diagnosis of the participants. Table 3 showed the frequency of the findings on the endoscopic assessment of the pharyngeal end of the Eustachian Tube. Mild edema (47.2%), mild erythema (46.3%) and scanty exudates (42.6%) were found more commonly among participants. However, mucopurulent discharge (31.5%) was also found most. Tubal tonsils were mostly absent at the ET orifice (49.1%) while good opening of the ET occurred more often (66.7%) on swallowing.

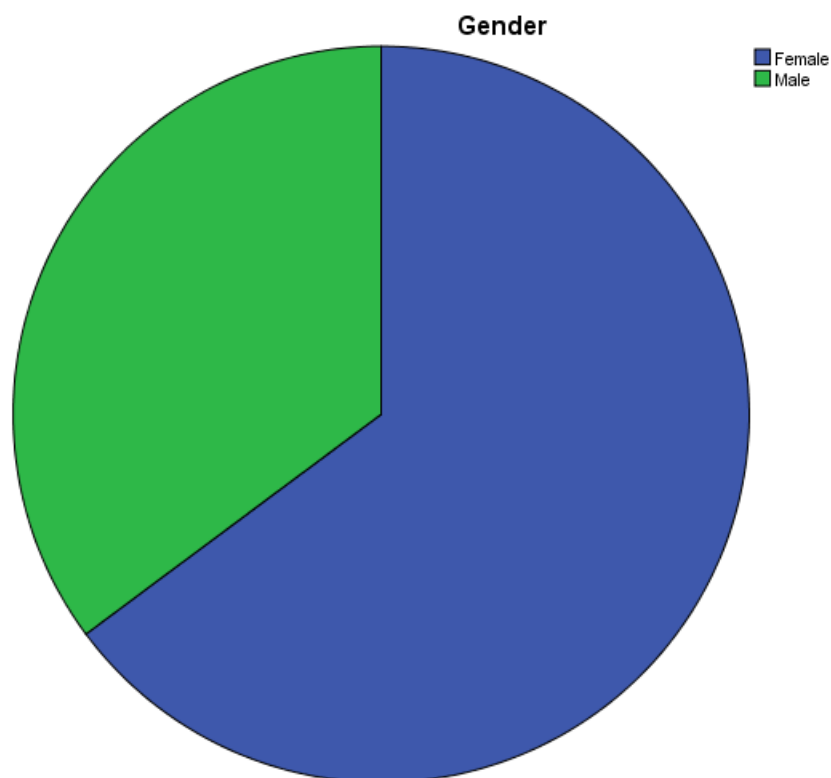


Figure 1: Gender distribution of all participants

Table 1: Eustachian Tube Dysfunction Questionnaire (ETDQ-7) scores and Tympanometry pattern of participants

Eustachian Tube Dysfunction Questionnaire (ETDQ-7) scores				χ^2	<i>p</i> value
	Normal n (%)	Abnormal n (%)	Total N (%)		
Tympanometry					
Type A	21 (67.7)	10 (32.3)	31(58.5)	6.6639	0.009839*
Type B and C	7 (31.8)	15 (68.2)	22 (41.5)		
Total	28 (52.8)	25 (47.2)	53 ^a (100%)		

χ^2 : Chi square test; *: *p* value <0.05 (i.e. statistically significant); ^a: the participant with Type As tympanometry was not represented on this table.

Table 2: Relationship between grades of tinnitus functional index scores and age, gender, tinnitus ears, duration of tinnitus and associated hearing loss of all participants

Variable	Four-point mucosal inflammatory grading system				χ^2	<i>p</i> value
	I	II	III	IV		
	n(%)	n(%)	n(%)	n(%)		
Tympanometry results						
Type A	11 (35.5)	11 (35.5)	7 (22.6)	2 (6.4)	11.9284	0.007632*
Type B and C	1 (4.5)	5 (22.7)	10 (45.5)	6 (27.3)		

Variable	Four-point mucosal inflammatory grading system				χ^2	<i>p</i> value
	I n(%)	II n(%)	III n(%)	IV n(%)		
ETDQ-7						
Normal	11 (37.9)	11 (37.9)	3 (10.3)	4 (13.8)	3.9186	0.270393
Abnormal	7 (28.0)	7 (28.0)	8 (32.0)	3 (12.0)		
Diagnosis						
OME	9 (25.8)	14 (40.0)	6 (17.1)	6 (17.1)	4.908	0.178656
CRS	9 (47.4)	4 (21.1)	5 (26.3)	1 (5.2)		

ETDQ-7: 7-item Eustachian Tube Dysfunction Questionnaire; OME: Otitis Media with Effusion; CRS: Chronic Rhinosinusitis; χ^2 : Chi square test; *: *p* value <0.05 (i.e. statistically significant)

Table 3: Endoscopic assessment of the pharyngeal end of the ET in both nasal cavities

Findings		Right	Left	Total	Percentage (%)
Edema	Nil	22	19	41	38.0
	Mild	25	26	51	47.2
	Severe	7	9	16	14.8
Erythema	Nil	23	21	44	40.7
	Mild	26	24	50	46.3
	Severe	5	9	14	13.0
Exudate	Nil	14	14	28	25.9
	Scant	24	22	46	42.6
	Copious	16	18	34	31.5
Nature of Discharge	Watery	1	2	3	2.8
	Thin mucoid	13	12	25	23.1
	Thick mucoid	11	13	24	22.2
	Mucopurulent	17	17	34	31.5
	No discharge	12	10	22	20.4
Tubal tonsil	Absent	27	26	53	49.1
	Present but lumen is not involved	23	22	45	41.7
	Present and lumen is involved	4	6	10	9.2
Effect of swallowing on ET orifice	Good opening	36	36	72	66.7
	Impaired	17	14	31	28.7
	Failed to open	1	4	5	4.6

ET: Eustachian Tube

Discussion

The mechanical obstruction and congestion of the orifice of the Eustachian tube (ET) due to inflammation of its lymphoreticular tissue and mucosa edema with either a complete blockage or narrowing of the opening can occur as a result of or part of the spectrum of an ongoing nasal or middle ear disease. The obstruction results into a reduction in the mucociliary clearance which may impede ventilation or encourage ascending infection into the middle ear.^{3,10} Diagnostic nasal endoscopy (DNE) has since been incorporated into the diagnosis criteria for chronic rhinosinusitis (CRS);²⁰ however, it is very important in the assessment of the

pharyngeal end of the ET for the purpose of assessment of the extent of affection of the ET orifice as part of the cascade of inflammatory process in CRS. In other words, DNE have become imperative in the diagnosis of CRS and part of the global evaluation of ET function in patients with Otitis Media with Effusion (OME). Similarly, as part of the spectrum of events in CRS, the inflammation of the pharyngeal end of the ET and ascending infective/inflammatory process can result into Eustachian Tube Dysfunction (ETD) and a resultant OME. Studies have shown that one of the major factors for developing ETD is the presence of CRS.^{11,21–23} In addition, the diagnostic and therapeutic

approach of OME is based on nasoendoscopic examination to rule out intranasal and nasopharyngeal abnormalities in relation to the pharyngeal end of the ET.^{24,25} This also helps to assess the effect and degree of ETD in the management of OME.²⁶ In this study, patients with OME and those who are diagnosed of CRS with suspected ETD had endoscopic assessment of the pharyngeal end of the ET.

The symptom scores for ETD (ETDQ-7) has proven to be very important in making correct diagnosis and evaluation as well as monitoring of treatment efficacy.¹³ This study revealed a prevalence of 46.3% of dysfunctional ET among the study population. Similar finding was recorded by previous studies.^{27,28} As a diagnostic tool, questions related to tinnitus, aural fullness and feeling of clogged ears are commonly reported in relation to OME with high scores when compared with those whose primary diagnosis were CRS. Similar to earlier reports, aural fullness scaled highest and followed closely by ringing in the ears and the sensation of clogged ears in this study.^{28–30}

About 40 percent of participants presented with type B and type C tympanometry report related to ETD. This is in keeping with previous studies that reported the effect of inflammation on the ET and subsequent middle ear functions.^{21,22} This finding is not too different from the prevalence of ETD found on ETDQ-7 (46.3%). Similarly, this study reported a higher tendency for patients with abnormal ETDQ-7 to present with abnormal tympanometry. The relationship between findings on ETDQ-7 and tympanometry was also statistically significant. In a recent study by Moon et al, the findings on ETDQ-7 is not well correlated with their test of Eustachian tube function owing to the subjectivity of ETDQ-7. However, they agree with the suggestion of a gross evaluation technique which involves both subjective and objective assessment tools.³¹ Though, tympanometry is useful in detecting middle ear effusions and demonstrates high sensitivity and specificity, its efficacy in diagnosing ETD is limited as about 60% of patients in this study had normal tympanometry results. This emphasizes the limitation to detect mild ETD cases.³² It will therefore be difficult to diagnose and assess ETD by using a specific evaluation tool because of the complexity of the functional anatomy and physiology of the ET. Various tools such as otoscopic appearance, visual grading of endoscopic findings, Eustachian Tube Score (ETS), ETDQ-7,

tympanometry, Valsalva manoeuvre, pure tone audiometry, sonotubometry and tubomanometry, have been used, but none has been completely reliable nor considered the gold standard test for the assessment of ET function.^{1,16}

Cardinal signs of inflammation which includes edema, erythema and sometimes exudates have the potential to either occlude the ET orifice and/or cause dilatory dysfunctions. In addition the presence of a tubal tonsil implies inflammation of the lymphoid follicle.¹⁸ These features can be easily identified on endoscopic examination and they are also features that are commonly associated with diseases of the upper aerodigestive tract. A larger number of patients in this study had mild edema, mild erythema and scanty exudates around the ET orifice. For those who had copious exudates, the nature of the discharge was largely mucopurulent. The tubal tonsil was absent in about half of the patients and most of those whose tonsils were present didn't have it occluding the lumen of the ET. Therefore, it is understandable why two-thirds of patients had good opening of the ET on swallowing.

The four-point mucosal inflammatory grading system of the pharyngeal end of the ET has also helped to categorize all the inflammatory features related to the ET orifice into grades.⁷ The highest number of patients were found in grade II which is related to the presence of edema or erythema with no apparent compromise of ET dilation while swallowing. This is closely followed by those in grade I with normal pink mucosa (no inflammation) and good ET dilation on swallowing.

This study also noted that grade II is more common in patients with OME while grade I was seen commonly among those with CRS. Similar findings were also documented by previous researchers.^{11,33} Though there was no statistically significant association between the endoscopic assessment and ETDQ-7, higher number of those with poor ETDQ-7 scores had grade III endoscopic grading which implied that edema and erythema was present with partially dysfunctional ET function during swallowing. Those with frank edema and erythema with difficulty in opening the ET on swallowing (grade IV) only occurred in about ten percent of the population. As reported in our study, Grade IV is generally the least type among participants with CRS and OME.^{11,33}

Inflammatory process occurring around the pharyngeal orifice of the ET mostly results into dilatory dysfunction. The rating of the degree of inflammation in the mucosa within the lumen of the ET should always be evaluated, not only in the resting position, but also in the active dilation phase.²⁴ Endoscopic examination of this pharyngeal end of the ET orifice yields significant information about the function of ET which was graded with mucosal inflammatory grading systems in this study. Endoscopic studies of the ET have been able to confirm the suspicion that the majority of dysfunctional tubes are functional and not anatomically obstructed. Although, the anatomical obstruction of the ET that can occur from intranasal or nasopharyngeal masses were not put into consideration in the endoscopic scale^{7,8} and were therefore excluded from this study. Again, it is glaring that there is no single test for a proper assessment of both the anatomical and physiological functions of the ET. Therefore, evaluating with ETDQ-7 in combination with tympanometry and mucosal endoscopic assessment of the ET will improve the diagnosis of ETD.^{15,34} However, more study is ongoing on the use of Dynamic Slow-motion Video Endoscopy (DSVE) as a single standard test for ETD to enhance the diagnostic accuracy by enabling direct observation of ET functions and expediting the identification of specific pathologies contributing to ETD symptoms.³⁵

Conclusion

This study has reemphasized the fact that ETD are more of physiological obstruction than anatomical, making it more difficult to rely on one evaluation tool as a standalone or gold standard for the assessment of ET functions. The combination of the ETDQ-7 scoring system with more objective assessments tools for evaluating the ET functions will give a more reliable report for otitis media with effusion and chronic rhinosinusitis. This will definitely influence the treatment strategies because improvement in ET functions remains a pivotal in the proper management of aforementioned ENT problems.

Declarations

Authors' contributions

AA: Conception, design, drafting, supervision of the study work, data collection, analysis and interpretation. Agreement 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, final approval of the version to be published.

SOA: Conception and the design of the research work. Ensured that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Involved with data analysis, interpretation and final approval of the version to be published.

OCE: Involved with drafting the whole study, revising the work critically for important intellectual content. Agreement to be accountable for all aspects of the work and final approval of the version to be published.

SCU: Drafting and administration of questionnaires, data collection and interpretation of the research work. Agreement to be accountable for all aspects of the work and final approval of the version to be published.

Availability of data and material

The raw data for this study is in the custody of the authors of this research work and could be made available on request.

Competing interests

There was no competing interest to disclose

Funding

The financial implication of the whole study was the sole responsibility of the authors. There was no institutional or external funding.

Ethics approval and consent to participate

Ethical clearance with protocol number ERC/2023/10/25 was duly obtained from the Ethical and Research Committee of the Obafemi Awolowo University Teaching Hospital Complex Ile-Ife, Nigeria before commencement of the study. In addition, written informed consent was obtained from all participants that met the inclusion criteria after a clear and satisfactory explanation of the objectives, nature and processes of the study to them.

Consent for publication

A written informed consent to publish the data collected was given by both the participants and the research committee of our institution without approval to publish the personal details or any information that can be traced to any of the participant.

References

1. Schilder A, Bhutta MF, Butler CC, Kvaerner K, Holy C, Levine LH, et al. Eustachian tube dysfunction: Consensus statement on definition,

- types, clinical presentation and diagnosis. *Clin Otolaryngol.* 2015; 40:407–11.
2. Rennie CE, Gutierrez M, Darby Y, Lund VJ. Investigation of the incidence of Eustachian tube dysfunction in patients with sinonasal disease. *Rhinol Online.* 2018; 1:85–9.
 3. Bluestone CD, Klein JO. Otitis Media and Eustachian Tube Dysfunction. In: Bluestone C, Simons J, Healy G, editors. *Pediatric Otolaryngology.* 5th ed. Shelton: People's Medical Publishing House-USA; 2014. p. 633–760.
 4. Browning GG, Wormald PJ. Clinical Examination of The Ears and Hearing. In: Watkinson JC, Clarke RW, editors. *Scott-Brown's Otorhinolaryngology Head and Neck Surgery.* 8th ed. Boca Raton: CRC Press; 2018. p. 926–8.
 5. Vila PM, Thomas T, Liu C, Poe D, Shin JJ. The Burden and Epidemiology of Eustachian Tube Dysfunction in Adults. *Otolaryngol Head Neck Surg.* 2017; 156:278–84.
 6. Choffor-Nchinda E, Siafa AB, Nansseu JR. Otitis media with effusion in Africa-prevalence and associated factors: A systematic review and meta-analysis. *Laryngoscope Investig Otolaryngol.* 2020; 5:1205–1216.
 7. Kivekäs I, Pöyhönen L, Aarnisalo A, Rautiainen M, Poe D. Eustachian Tube Mucosal Inflammation Scale Validation Based on Digital Video Images. *Otol Neurotol.* 2015;36(10):1748–52.
 8. Poe DS, Abou-halawa A, Abdel-razek O. Analysis of the Dysfunctional Eustachian Tube by Video Endoscopy. *Otol Neurotol.* 2001; 22:590–5.
 9. Upadhyay I, Datar J. Treatment Options in Otitis Media with Effusion. *Indian J Otolaryngol Head Neck Surg.* 2014;66(Suppl 1):S191–S197.
 10. Stammberger H. Secretion Transportation. In: Hawke M, editor. *Functional Endoscopic Sinus Surgery.* Philadelphia: Decker, BC; 1991. p. 17–47.
 11. Patel S, Dasgupta KA, Mustafa A, Sood R. Is Chronic Rhinosinusitis and Status of Pharyngeal End of Eustachian Tube Link-Up: All Smoke No Fire? *Int J Contemp Med Res.* 2016;3(6):1682–4.
 12. Llewellyn A, Norman G, Harden M, Coatesworth A, Kimberling D, Schilder A, et al. Interventions for adult Eustachian tube dysfunction: a systematic review. *Heal Technol Assess.* 2014;18(46):1–204.
 13. Menezes AS, Ribeiro, Daniela Correia Guimaras, Joana Rocha Costa I, Moreira F, Dias L. Translation and Validation of the “7-Item Eustachian Tube Dysfunction Questionnaire” to European Portuguese (PT). *Acta Med Port.* 2020;33(3):191–7.
 14. Hunter LL, Sanford CA. Tympanometry and Wideband Acoustic Immittance. In: Katz J, Chasin M, English K, Hood L, Tillery K, editors. *Handbook of Clinical Audiology.* 7th ed. Philadelphia: Wolters Kluwer Health; 2015. p. 137–63.
 15. Mathew GA, Kuruvilla G, Job A. Dynamic slow motion video endoscopy in eustachian tube assessment. *Am J Otolaryngol.* 2007;28(2):91–7.
 16. Augustine AM, Varghese L, Michael RC, Alber RR, Job A. The efficacy of dynamic slow motion video endoscopy as a test of eustachian tube function. *Laryngol Otol.* 2013; 127:650–5.
 17. McCoul ED, Anand VK, Christos PJ. Validating the Clinical Assessment of Eustachian Tube Dysfunction: The Eustachian Tube Dysfunction Questionnaire (ETDQ-7). *Laryngoscope.* 2012;122(5):1137–1141.
 18. McCoul ED, Mayer SI, Tabaei A, Bedrosian JC, Marino MJ. Endoscopic Evaluation of the Eustachian Tube: assessment of a novel tool for grading Eustachian tube inflammation. *Int Forum Allergy Rhinol.* 2019;9(3):305–10.
 19. Fisher A, Stockel J, Townsend J. Sampling and sample size determination. In: *Handbook for family planning operations. Research and design.* 2nd ed. New York: The population council; 1983. 1–98 p.
 20. Fokkens WJ, Lund VJ, Hopkins C, Hellings PW, Kern R, Reitsma S, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2020. *Rhinology.* 2020;58(Suppl S29):1–464.
 21. Daval M, Picard H, Bequignon E, Bedbeder P, Coste A, Ayache D, et al. Chronic otitis media with effusion in chronic sinusitis with polyps. *Ear, Nose, Throat J.* 2018;97(8):13–8.
 22. Hong CK, Park DC, Kim SW, Chang C, Cha S, Yeo SG. Effect of paranasal sinusitis on the development of otitis media with effusion: Influence of Eustachian tube function and adenoid immunity. *Int J Pediatr Otorhinolaryngol.* 2008; 72:1609–18.
 23. Browning GG, Gatehouse S. The prevalence of middle ear disease in the adult British population. *Clin Otolaryngol Allied Sci.* 1992;17(4):317–21.
 24. Finkelstein Y, Ophir D, Talmi YP, Shabtai A, Strauss M, Zohar Y. Adult-Onset Otitis Media with Effusion. *Arch Otolaryngol Head Neck Surg.* 1994; 120:517–27.
 25. Benninger MS, Ferguson BJ, Hadley JA, Hamilos DL, Jacobs M, Kennedy DW, et al. Adult chronic rhinosinusitis: definitions, diagnosis, epidemiology, and pathophysiology. *Otolaryngol neck Surg.* 2003;129(3 Suppl):S1–32.

26. Robb PJ, Williamson I. Otitis media with effusion. In: Watkinson JC, Clarke RW, editors. Scott-Brown's Otorhinolaryngology Head and Neck Surgery. 8th ed. Boca Raton: CRC Press; 2018. p. 115–6.
27. Tangbumrungtham N, Patel VS, Thamboo A, Patel Z, Nayak J V, Ma Y, et al. The prevalence of Eustachian tube dysfunction symptoms in patients with chronic rhinosinusitis. *Int Forum Allergy Rhinol*. 2018;8(5):620–3.
28. Wu AW, Walgama ES, Higgins TS, Borrelli M, Vardanyan N, Hopp S, et al. Eustachian Tube Quality of Life and Severity of Disease in Patients with Chronic Rhinosinusitis. *Am J Rhinol Allergy*. 2020;34(4):532–6.
29. Stoikes NFN, Dutton JM. The Effect of Endoscopic Sinus Surgery on Symptoms of Eustachian Tube Dysfunction. *Am J Rhinol*. 2005; 19:199–202.
30. Yang K-S, Chen W-C, Wu C-N, Wee Y-S, Wang C-S, Wu C-C, et al. Endoscopic Sinus Surgery Significantly Reduces Eustachian Tube Dysfunction Symptoms in Patients with Chronic Rhinosinusitis: A Systematic Review and Meta-Analysis. *Biomedicines*. 2024; 12:2484.
31. Moon S, Lee Y, Jung J, Moon IS, Bae SH. Association Between Eustachian Tube Dysfunction Questionnaire-7 scores and Eustachian Tube Function Test Results in Symptomatic Patients with a Normal Drum. *J Audiol Otol*. 2022;26(3):142–6.
32. Hsieh C-Y, Lin W-C, Lin C-C, Chou Y-F. Combined balloon Eustachian tuboplasty/endoscopic sinus surgery for patients with chronic rhinosinusitis and Eustachian tube dysfunction. *Int Forum Allergy Rhinol*. 2024; 14:1327–1336.
33. Takahashi H, Honjo I, Fujita A. Endoscopic findings at the pharyngeal orifice of the Eustachian tube in otitis media with effusion. *Eur Arch Otorhinolaryngol*. 1996; 253:42–4.
34. Padhya C, Sharma Y, Mishra G. To assess the efficacy of modality slow motion dynamic video endoscopy of eustachian tube in chronic middle ear pathologies. *Indian J Otolaryngol Head Neck Surg*. 2015;67(1):81–7.
35. Patil N, Jain S, Wadhwa S. Unveiling the Potential: A Comprehensive Review of Dynamic Slow-Motion Video Endoscopy for Eustachian Tube Dysfunction Evaluation. *Cureus*. 2024;16(7):e63811.