International Journal of Otorhinolaryngology and Head and Neck Surgery
Munjal M et al. Int J Otorhinolaryngol Head Neck Surg. 2025 Aug;11(4):491-494
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937
DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20252270

Review Article

Eustachian tube functions, revisited: a review

Manish Munjal[1], Shubham Munjal[1]*, Vineeta Arora[2], Loveleen Sandhu[1], Swati Chauhan[1], Garima Bansal[1], Rubaldeep[1], Manik Kaushal[1], Sakshi Jarewa[1], Prachee Budhiraja[1], Sidharth Chopra[1], Sharan Kaur[1], Muskan Ahluwalia[1]

[1]Department of ENTHNS, Dayanand Medical College, Ludhiana, Punjab, India
[2]Guru Teg Bahadur Hospital, Ludhiana, Punjab, India
[3]Department of Medicine, Dayanand Medical College, Ludhiana, Punjab, India

Received: 08 March 2025
Revised: 16 July 2025
Accepted: 18 July 2025

***Correspondence:**
Dr. Shubham Munjal,
E-mail: manishmunjaldr@yahoo.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Myringoplasty conventionally is the reconstitution of the perforated tympanic membrane. There is a state of equilibrium between nasopharyngeal, middle ear and the external ear, air pressures. Middle ear ventilation and drainage is undertaken by the eustachian tube, a partially collapsible and rigid pipe linking the nasopharynx with the middle ear. There are controversial views regarding the value of a preoperative assessment of the function of the eustachian tube. Historically active and passive procedures for evaluation of the tubal function are vital components of the otological test battery. Outpatient tests like the Valsalva may not necessitate acquisition of sophisticated armamentarium but sono-tubometry and tube-manometry do so and are a bit expensive. The variety of subjective and objective tests have been elaborated upon wrt a successful uptake of the graft in myringoplasty.

Keywords: Eustachian tube, Sono tubometry, Tympanometry, Valsalva

INTRODUCTION

The ventilation and drainage of the middle ear is carried out by the Eustachian tube, which is a partially collapsible and a rigid conduit joining the nasopharynx and the middle ear. Positive and negative pressures in the middle ear are likely to perforate or collapse the tympanic membrane. Uptake of the ear drum anatomically and its mobility physiologically necessitates an optimal positioning that is dependent on a well-functioning Eustachian tube. Various active and passive tests for evaluation of the tubal function have been utilized by otologists for a long time.

REVIEW

Otologists have incorporated various subjective and objective procedures to evaluate the ventilatory and drainage functions of the eustachian tube prior to surgical intervention and attempted to correlate the surgical outcome.

The inflatory methods such as Valsalva maneuver and eustachian tube catheterization only indicate a forcible air entry into the middle ear and do not give an accurate estimate of the ventilatory capacity of the eustachian tube. Flisberg et al suggested that normally when the air in the middle ear is absorbed, the tube opens reflexly during swallowing in response to the negative pressure dip in the middle ear.[1]

Dutta et al, documented that the "Bortnick Miller" test is based on physiological principle of aspiration of air into the middle ear cavity under normal conditions and provided the most reliable information about the tubal function at the time of examination.[2]

Studies of Zollner et al, Wullstein et al and Farrior et al suggested that tubal dysfunction lead to many failures in tympanoplasty.[3-5] Researchers House and Holmquist considered normal eustachian tube function to be a prerequisite for a successful tympanoplasty whereas hypofunction is taken to be a highly unfavorable sign and even a contra-indication to surgery.[6,7] Podoshin et al, carried out tympanoplasty in 51 children with a success rate of 92%. They found out that functioning eustachian tube was an important factor for uptake of the graft.[8] An audiological improvement was seen in 70.6% of patients.[8] However, Sheehy et al reported a 97.5% healing rate at four months after surgery without mentioning any such tests of tubal function.[9] Ekvall reported that eustachian tube function allows no predictability of the surgical outcome.[10]

Holmquist et al emphasized that preoperative eustachian tube function evaluation can prognosticate outcome. The results of tympanoplasty when co-related to preoperative tubal functions showed that in the group with a good function the success rate was 75% whereas in the hypo functioning group the graft almost failed in 90% cases.[11] Holmquist et al observed that graft uptake was related to volume of air in the mastoid air cell system. Mastoids with a large cell volume exhibited a significantly better healing of tympanic membrane after tympanoplasty.[11]

Ekvall reviewed 203 tympanoplasties to estimate the role of preoperative evaluation of tubal function in hearing and healing. As a routine, Politzer and Valsalva inflation were utilized as preoperative tubal tests. Healed drums were noted in 79-97%. A serviceable hearing or AB gap within 10 or 15 dB was achieved in 71-96% cases. It was concluded that tympanoplasty should not be contra-indicated on the basis of preoperative tubal tests.[10]

Sengupta et al achieved 91.3% success rate in a cohort series with normal eustachian function in 85.5% subjects.[12] In normal eustachian tube function otologists of repute achieved results as: Miller and Bilodeau 88%, Holmquist 75%, Palva et al 77%.[11,13,14] On the contrary in hypo functioning eustachian tube the success rate of other researchers was: Ekvall 100%, Palva et al 82%, Mackinnon 82%.[10,14,15] A high failure rate has been reported in poor eustachian tube function group by: Miller et al, 33% and Holmquist 12%.[11,13]

Holmquist et al and Sharp et al advocated strongly that a successful tympanoplasty results in an aerated tympanum, the prerequisite of which is a well-functioning Eustachian tube. This is often achieved by surgery.[11,16] Anderson et al and Harris et al observed that poor tubal function in chronic otitis media might be secondary to other factors responsible for the disease. In a postoperative study on hearing and healing in 100 patients, no positive correlation between these findings could be made out.[17] Algarra et al studied the prognostic value of mucociliary clearance in predicting success in tympanoplasty. They correlated the surgical outcome with mucociliary transport and concluded that the normal transport time percentage is considerably higher in the success group (50%) than in the failure group (22%).[18] House et al, emphasized that they did not perform eustachian tube function tests at their institute.[19]

Effects for eustachian tube functions

Anderson et al did not note a positive correlation between healing or hearing and tubal function.[17] Virtanen et al and Palva et al showed a relation between tubal function tests and healing. The results indicated that absent or partial pressure equalization ability correlated with the successful outcome of surgery.[20] Holmquist et al and Linderman et al documented that tubal evaluation allows an identification of subjects who must be followed up with extra care during the postoperative period, thereby untoward sequel as reformations of the tympanic membrane may be avoided.[21]

Holmquist et al noted that the in most ears with poor preoperative tubal functions the poor status continues after surgery as judged by tympanometry and the tubal function test battery.[11] Gimenez et al and Marco-Algarra et al correlated studied the effect of pressure equalization mucociliary clearance of Eustachian tube and degree of pneumatization of the mastoid with results of myringoplasty. The only significant correlation was mucociliary clearance time.[18] Tympanometry, sono tubometry and tub manometry are the recent tests with a superior potential as assessment tools for Eustachian function for an obstructive tubal dysfunction.[22] There is however necessity for further validation of these techniques.

The tubal impedance test has also been described as a modification of tubo-manometry, whereby middle ear pressure changes are detected with a tympanic impedance probe.[23] In tympanic membrane perforations or grommets in situ, alternative tubal opening tests are utilized, i.e., the inflation-deflation and forced response tests, the latter evaluates the passive opening.[24] Tubal opening can even be assessed with a sound stimulus transmitted via the nose to the ear, through the momentarily patent Eustachian tube, a test known as sono tubometry. Peaks in the transmitted sound synchronous with swallowing are interpreted as tubal opening, assessed in terms of amplitude or shape.[24-26]

Nasopharyngeal endoscopy too has been described as an assessment tool for tubal function, to confirm both its patency and opening with correlation shown with other tests of ET opening.[27-32]

Thus, vis a vis in evaluation of the eustachian tube function, the three parameters are taken into account gaseous transfer and pressure equalization between the nasopharynx and middle ear, clearance of secretions from the middle ear cleft by both muscular action and

mucociliary transport and prevention of pathogens, sound and fluid reflux from the nasopharynx.[33,34]

All tests are safe, non-invasive, with minimal to nil patient discomfort. They are quick procedures and even complex ones can be repeated several times within a 10 min period.[22] There is of course a learning curve for the test operator and a prerequisite, is a provision of a dedicated audiologist or in clinics. While tests such as the observed Valsalva do not require specialist equipment, sono-tubometry and tubo-manometry availability is currently limited and incurs additional costs.

CONCLUSION

Preoperative evaluation is quick, safe, non-invasive and reproducible with minimal discomfort. They do require a learning curve for the audiologist. Observational tests like the Valsalva do not require sophisticated equipment but sono-tubometry and tube-manometry do so and are a bit expensive. There are controversial views regarding the value of a preoperative assessment of the eustachian functioning. The variety of subjective and objective tests have been elaborated upon wrt a successful uptake of the graft in myringoplasty.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Flisberg K, Ingelstedt S, Örtegren U. Controlled “ear aspiration” of air: A “physiological” test of the tubal function. Acta Oto-Laryngologica. 1963;56(182):35-8.
2. Dutta NN, Kacker SK, Sinha A. Eustachian tubal function in health and diseases. Indian J Otolaryngol. 1971;23:163-75.
3. Zollner F. Therapy of the Eustachian tube. Arch Otolaryngol. 1963;78(3):186-91.
4. Wullstein HL. Past and future of tympanoplasty. Arch Otolaryngol. 1963;78(3):163-77.
5. Farrior JB. Total Tympanoplasty Type V: Eustachian Tube Patency in Tympanoplasty. Arch Otolaryngol. 1965;81(4):398-409.
6. House WF. The function of the Eustachian tube. AMA Arch Otolaryngol. 1960;71(3):405-7.
7. Holmquist J. The role of the Eustachian tube in myringoplasty. Acta oto-laryngologica. 1968; 66(6):289-95.
8. Podoshin L, Fradis M, Malatskey S, Ben-David J. Tympanoplasty in adults: a five-year survey. Ear, Nose Throat J. 1996;75(3):149-56.
9. Sheehy JL, Glasscock ME. Tympanic membrane grafting with temporalis fascia. Arch Otolaryngol. 1967;86(4):391-402.
10. Ekvall L. Eustachian tube function in tympanoplasty clinical aspects. Acta Oto-Laryngologica. 1970;69(263):33-42.
11. Holmquist J. Middle ear ventilation in chronic otitis media. Arch Otolaryngol. 1970;92(6):617-23.
12. Sengupta RP, Kacker SK. Study of Eustachian tube function with particular reference to long term follow up in myringoplasty. Indian J Otolaryngol. 1974;26:132-7.
13. Miller GF. Eustachian tubal function in normal and diseased ears. Archives of Otolaryngology. 1965;81(1):41-8.
14. Palva A, Kärjä J. Eustachian—tube patency in chronic ears preoperative evaluation correlated to postoperative results. Acta Oto-Laryngologica. 1970;69(sup263):25-8.
15. MacKinnon DM. Homograft tympanic membrane in myringoplasty. Ann Otol Rhinol Laryngol. 1972;81(2):194-202.
16. Sharp M. The manometric investigation of tubal function1: with reference to myringoplasty results. The J Laryngol Otol. 1970;84(6):545-51.
17. Anderson L, Harris S. Middle ear mechanics and Eustachian tube function in tympanoplasty. Acta Oto-Laryngologica. 1978;86(360):141-7.
18. Gimenez F, Marco-Algarra J. The prognostic value of mucociliary clearance in predicting success in tympanoplasty. J Laryngol Otol. 1993;107(10):895-7.
19. House WF, Iii ME, Miles J. Eustachian tuboplasty. The Laryngosc. 1969;79(10):1765-82.
20. Vartiainen E, Kärjä J, Karjalainen S, Härmä R. Failures in myringoplasty. Arch Oto-rhino-laryngol. 1985;242:27-33.
21. Lindeman P, Holmquist J, Åberg B. Ear drum mobility and middle ear volume measured with tympanometry. Scandinavian Audiol. 19841;13(3):147-50.
22. Smith ME, Takwoingi Y, Deeks J, Alper C, Bance ML, Bhutta MF, et al. Eustachian tube dysfunction: a diagnostic accuracy study and proposed diagnostic pathway. PLoS One. 2018;13(11):206946.
23. Smith ME, Zou CC, Blythe AJ, Tysome JR. Tuba-impedance: a new test of Eustachian tube function. Otolaryngol Head Neck Surg. 2017;156(4):717-21.
24. Doyle WJ, Swartz JD, Banks J, Casselbrant ML, Mandel EM, Alper CM. Sensitivity and specificity of Eustachian tube function tests in adults. JAMA Otolaryngol–Head Neck Surg. 2013;139(7):76.
25. Asenov DR, Nath V, Telle A, Antweiler C, Walther LE, Vary P, et al. Sonotubometry with perfect sequences: first results in pathological ears. Acta oto-laryngologica. 2010;130(11):1242-8.
26. Pyne JM, Amoako-Tuffour Y, Earle G, McIntyre G, Butler MB, Bance M. Transmission of a novel sonotubometry acoustic click stimulus in healthy and patulous Eustachian tube subjects: a retrospective case-control study. J Otolaryngol Head Neck Surg. 2017;46(1):47.
27. Linstrom CJ, Silverman CA, Rosen A, Meiteles LZ. Eustachian tube endoscopy in patients with chronic ear disease. Laryngoscope. 2000;110(11):1884-9.

28. Di Martino E, Walther LE, Westhofen M. Endoscopic examination of the Eustachian tube: a step-by-step approach. Otol Neurotol. 2005;26(6):1112-7.
29. Poe DS, Pyykkö I. Measurements of Eustachian tube dilation by video endoscopy. Otol Neurotol. 2011;32(5):794-8.
30. Alper CM, Teixeira MS, Swarts JD, Doyle WJ. Quantitative description of Eustachian tube movements during swallowing as visualized by transnasal video endoscopy. JAMA Otolaryngol Head Neck Surg. 2015;141(2):160-8.
31. Han WG, Yoo J, Rah YC, Chang J, IM GJ, Song JJ, et al. Analysis of Eustachian tube dysfunction by dynamic slow motion video endoscopy and Eustachian tube dysfunction questionnaire in chronic otitis media. Clin Exp Otorhinolaryngol. 2017;10(4):315-20.
32. Augustine AM, Varghese L, Michael RC, Albert RR, Job A. The efficacy of dynamic slow motion video endoscopy as a test of Eustachian tube function. J Laryngol Otol. 2013;127(7):650-5.
33. Sadé J. Middle ear and auditory tube: middle ear clearance, gas exchange and pressure regulation. Otolaryngol Head Neck Surg. 1997;116(4):499-524.
34. Bluestone CD. Eustachian tube: structure, function, role in otitis media. PMPH-USA. 2005.

Cite this article as: Munjal M, Munjal S, Arora V, Sandhu L, Chauhan S, Bansal G, et al. Eustachian tube functions, revisited: a review. Int J Otorhinolaryngol Head Neck Surg 2025;11:491-4.