NT journal review

Eustachian Tube Dysfunction

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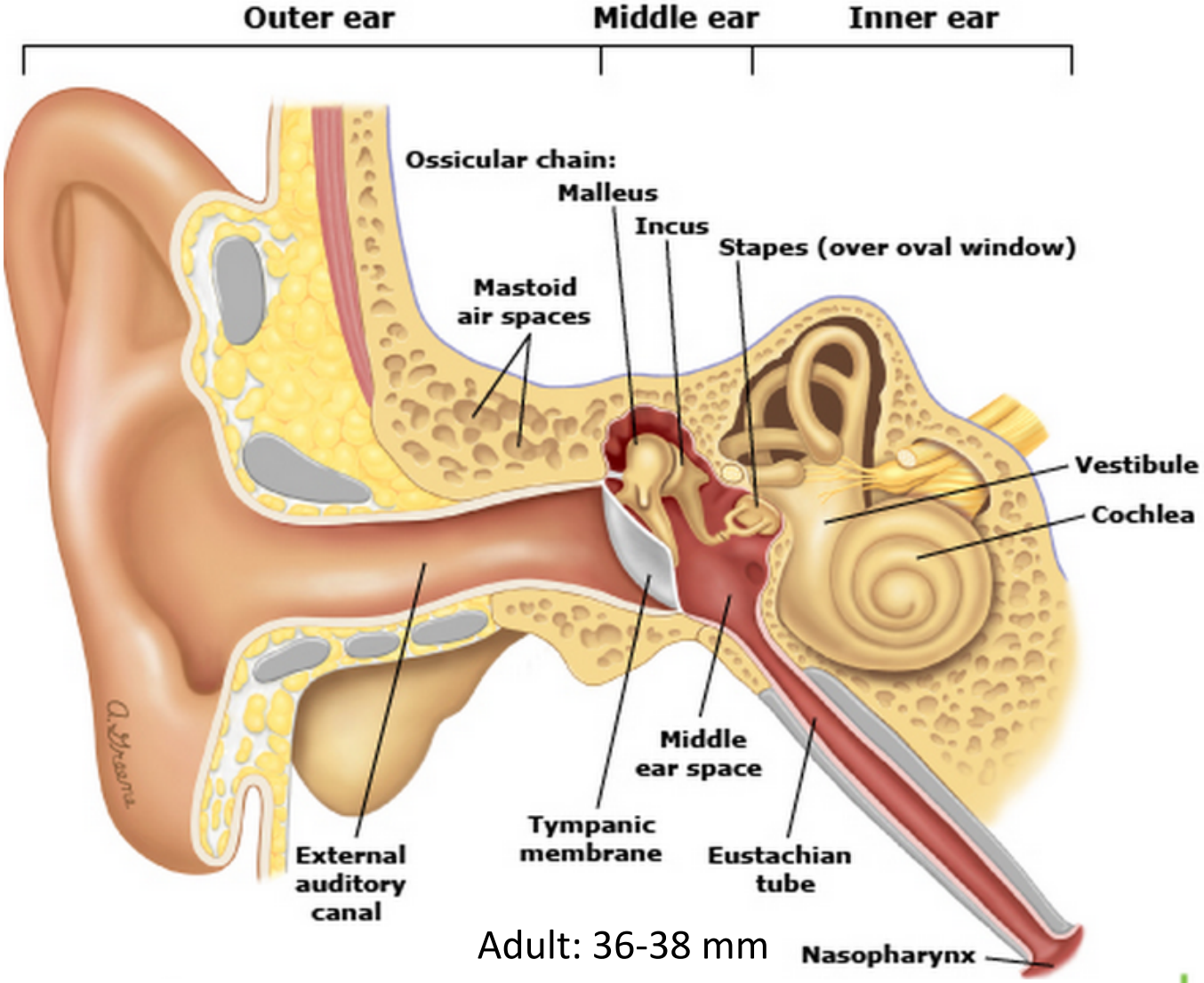
INTRODUCTION

- The middle ear is an air-filled chamber within the skull that is periodically vented when the eustachian tube opens.
- No well-accepted definition of eustachian tube dysfunction
- More accurately defined as **failure of the functional valve of the eustachian tube** to open and/or close properly

Anatomy



Adult: 36-38 mm

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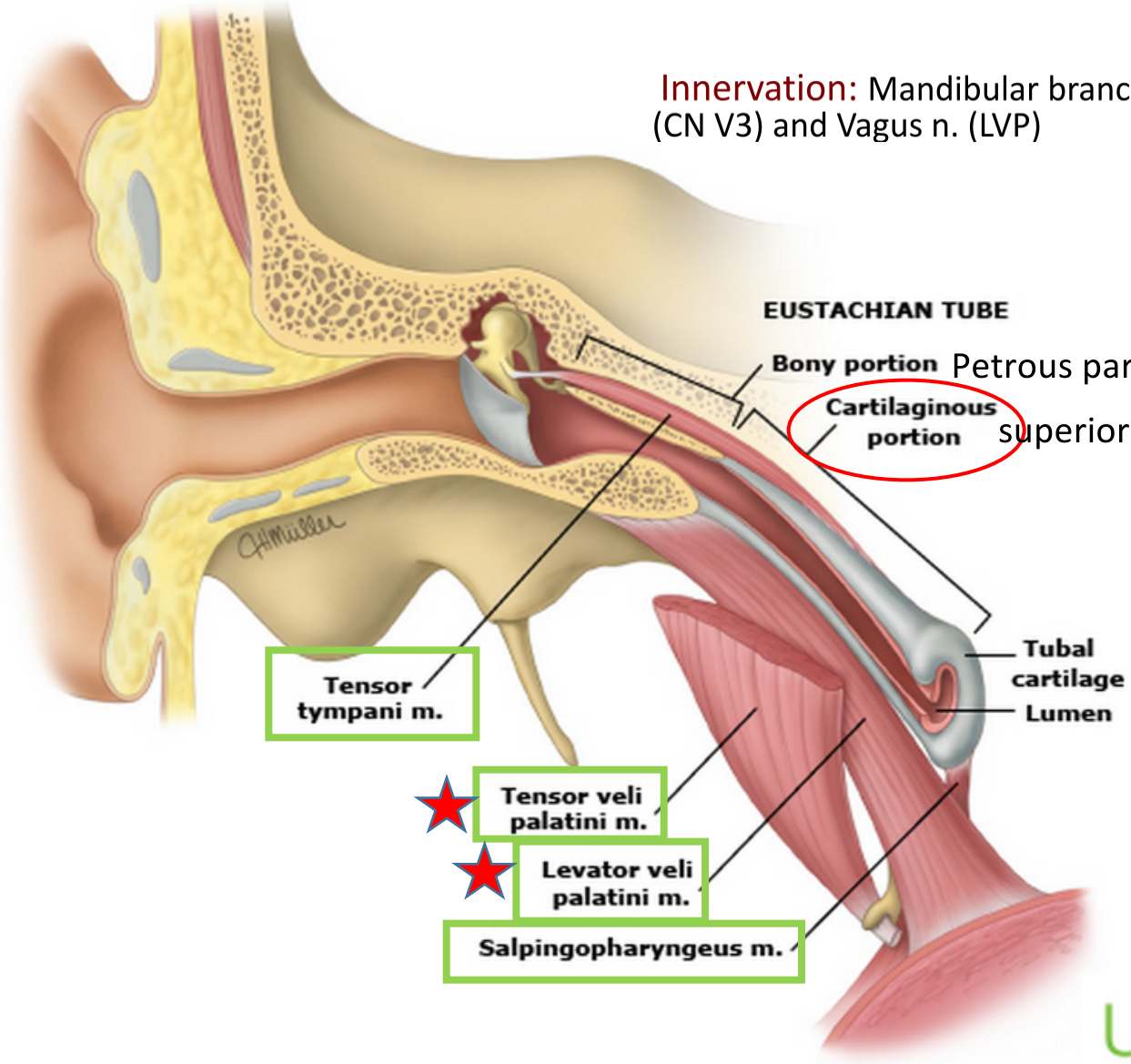
Anatomy

Innervation: Mandibular branch of trigeminal n. (CN V3) and Vagus n. (LVP)



Petrous part of temporal bone

superiorly to sphenoid bone

Normal function of E-tube

- Three functional roles
- **Equalization** of pressure across the tympanic membrane
- **Protecting** the middle ear from infection and reflux of nasopharyngeal contents
- **Clearance** of middle ear secretions
- Open when swallowing and yawning
- 84 times per hours in the daytime, less during sleep
- The valve is roughly 5 to 8 mm long in the middle of the cartilaginous portion of the tube.

Pathophysiology ~ Pressure dysregulation

- Fail to open adequately to allow for ventilation of the middle ear space
- Functional obstruction
- Mucosal inflammation with edema and secretions limiting the ability of the valve to open
- Failure of muscular actions
- Negative pressure make tubal muscles harder to dilate the lumen
- Floppy tube (young children with cleft palate, Down's syndrome, and other disorders with craniofacial anomalies)
- True anatomic obstruction: infrequently
- Severe inflammation of mucosa, adenoid mass, congenital or acquired stenosis, or nasopharyngeal neoplasm

Pathophysiology ~ Impaired protective function

- Reflux into the eustachian tube of nasopharyngeal pathogens, allergy-inducing proteins, gastric secretions, and sounds from one's own breathing or speaking (autophony).
- Reflux occurs in the following conditions:
- Abnormal patent E-tube due to congenital or acquired factors
- Short, floppy E-tube, creaniofacial anomalies (risk: Bottle-fed>breast-fed)
- Abnormal positive pressure in the nasopharynx (obstruction, blowing the nose, and crying)
- Loss of immune protection due to copious or viscous secretions, failre to expel pathogens
- Loss of mucosal protection from gastric enzymes and acid

Pathophysiology ~
Impaired clearance

- Loss of mucociliary function can result in the inability to clear viscous material and pathogens from the middle ear
- Primary loss of mucociliary function occurs in cystic fibrosis and other ciliary dysmotility disorders.
- Ciliary function may be secondarily impaired in inflammatory conditions.
- Impaired clearance may also be due to an obstructive process or inadequacy of tubal pump function.

Etiology

- Dilatory dysfunction:
- Failure of tubal dilatory action
- responsible for a large proportion of otitis media and chronic ear disease
- much more common than patulous dysfunction
- Patulous dysfunction
- valve incompetency leading to chronic patency (stuck open)
- bothersome symptoms
- Not lead to significant acute illness or chronic disease

Etiology~
Dilatory dysfunction

- Any cause of inflammation
- Allergies
- Irritants such as tobacco smoke, wood burning stoves, and pollution
- Laryngopharyngeal and gastroesophageal reflux
- Hormonal changes
- Primary mucosal disease (eg, granulomatous disease, Samter's triad)
- Ciliary disorders (eg, primary ciliary dyskinesia)
- Pressure dysregulation during scuba diving or descent during air travel
- Acquired anatomic abnormalities
- Nasopharyngeal masses
- Trauma (injury to palatopterygoid bone, trigeminal nerve or its mandibular branch)
- Congenital abnormalities (cholesteatoma, dermoid cysts, etc)
- Degenerative and metabolic diseases affecting the tubal musculature(ex MG)

Etiology~
Patulous dysfunction

- Weight loss, as little as a six pound reduction in weight (chronic illnesses, especially rheumatologic diseases)
- Scarring of mucosa as a result of previous procedures, inflammation, or radiation
- Neuromuscular disorders (eg, from cerebrovascular accidents, multiple sclerosis, poliomyelitis, traumatic injury to the trigeminal nerve)
- Allergy and chronic reflux of gastric contents, ultimately leading to mucosal atrophy.
- Hormonal factors (high estrogen levels in pregnancy or high dose oral contraceptives in women, estrogen therapy for prostate cancer in men)
- Others — nasal decongestants or cocaine, craniofacial abnormalities, palatal myoclonus, chronic gum chewing

Clinical evaluation

Dilatory dysfunction	Patulous tube dysfunction
• Ear pain, ear fullness or pressure, hearing loss, tinnitus, "**plugged**" • Popping and snapping noises • Vertigo and disequilibrium (negative pressure or MEE) • Delayed speech or language development	• **Autophony**! • Hearing his/her own voice and breathing sounds, "**talking into a barrel**" • Relieved with head in dependant position • Worsed by exercise and prolonged speaking
• Any retractions, effusions, atelectasis, cholesteatoma, perforations or tympanosclerotic plaques	• Excursions of tympanic membrane accompany the patient's breathing, stop after lying
• Conductive hearing loss	• nil
• Nasal endoscopy, Audiometry, and Radiographic imaging.	

Differential diagnosis

- Temporomandibular joint dysfunction
- Meniere's disease
- Superior semicircular dehiscence syndrome
- Ear blockage, disequilibrium, vertigo with loud noise, conductive hearing loss, and autophony
- MRI or high resolution CT scan

Treatment for Dilatory dysfunction

- Most commonly caused by inflammation
- If not bacterial infection, systemic decongestants (pseudoephedrine and phenylephrine), antihistamines, or nasal steroid sprays for presumptive viral rhinosinusitis or allergic rhinitis.
- Direct toward the suspected etiology of tubal dysfunction

Medical management for Dilatory dysfunction: Decongestants

- Systemic decongestants helpful for congestive symptoms (ear fullness or pressure)
- Systemic or topic decongestants are not effective in cases of OME

  Johnson D et al. *Intranasal phenylephrine-surfactant treatment is not beneficial in otitis media with effusion*. Int J Pediatr Otorhinolaryngol 2008; 72:1085

- Topical nasal decongestant sprays or drops may be used for symptomatic relief of nasal congestion or rhinitis with/without ear blockage symptoms
- Topical nasal decongestants may be helpful for difficulty clearing the ears during flights and scuba diving

  Shapiro GG et al. *Treatment of persistent eustachian tube dysfunction in children with aerosolized nasal dexamethasone phosphate versus placebo*. Ann Allergy 1982; 49:81

Medical management for Dilatory dysfunction: Glucocortisoids

- Animal studies have found oral methylprednisolone may be effective in relieving effusion and improving acute E-tube dysfunction.

  Aynali G, et al. *The effects of methylprednisolone, montelukast and indomethacine in experimental otitis media with effusion*. Int J Pediatr Otorhinolaryngol 2011; 75:15.

- Topical nasal steroids failure to show benefit in the absence of sinonasal inflammation.

  Gluth MB, et al. *Management of eustachian tube dysfunction with nasal steroid spray: a prospective, randomized, placebo-controlled trial*. Arch Otolaryngol Head Neck Surg 2011; 137:449

- No evidence of that 6 wks nasal steroids was effective in patients with OME +/- negative ME pressure.
- No evidence of changing tympanogram from B/C to type A.

  Norman, G., et al. *Systematic review of the limited evidence base for treatments of Eustachian tube dysfunction: a health technology assessment*. Clinical Otolaryngology 2014; 39, 6-21

Medical management for Dilatory dysfunction: Politzer maneuver

- A systematic review of six randomized trials found that Politzer devices are effective for treatment of otitis media with effusion in children.

Silman S, Arick D. *Efficacy of a modified politzer apparatus in management of eustachian tube dysfunction in adults*. J Am Acad Audiol 1999; 10:496

Perera R, et al. *Autoinflation for hearing loss associated with otitis media with effusion*. Cochrane Database Syst Rev 2006

- It is uncertain which patients with E-tube dysfunction would be most likely to benefit from Politzer devices.

Surgical management for Dilatory dysfunction

- Surgery is indicated when medical management fails.
- Tympanostomy tubes are indicated for persistence over 90 days despite medical therapy in children with OME secondary to E-tube dysfunction.
- Longer-term tympanostomy tubes may have a higher risk for subsequent tympanic membrane perforation

van Heerbeek N, et al. *Therapeutic improvement of Eustachian tube function: a review*. Clin Otolaryngol Allied Sci 2002; 27:50

- Eustachian tuboplasty: reduces the thickness of the mucosa and submucosa of the more bulky posterior-medial wall of the tubal orifice and lumen in order to facilitate tubal dilation.

AMERICAN ACADEMY OF OTOLARYNGOLOGY–HEAD AND NECK SURGERY FOUNDATION

Otolaryngol Head Neck Surg. 2015 Jan 20.

Balloon Eustachian Tuboplasty: A Systematic Review

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Abstract

OBJECTIVE: A systematic review and meta-analysis of the evidence on balloon Eustachian tuboplasty (BET) as a treatment modality for Eustachian tube dysfunction (ETD). We followed the PRISMA guideline and registered with PROSPERO No. CRD42014009461.

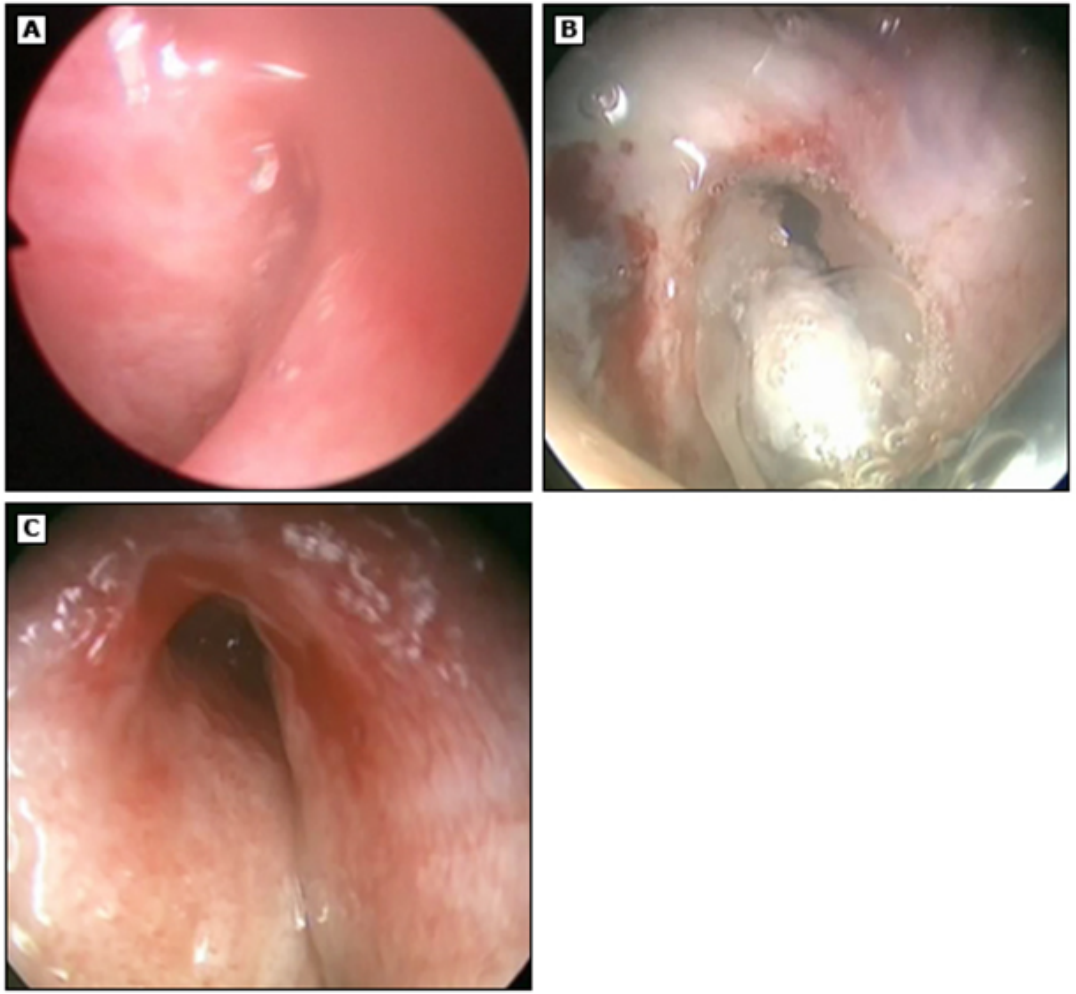
DATA SOURCES: We searched 12 databases including PubMed and Embase from January 1, 2010, to April 7, 2014, for studies of BET. Endpoints: change in symptoms, middle ear pathology, eardrum status, Eustachian tube function tests, hearing, adverse events, complications, and health-related quality of life.

REVIEW METHODS: Study quality was assessed using the modified Delphi technique quality appraisal tool for case series studies. Risk of bias was assessed using the Cochrane Collaboration's tool for assessing risk of bias.

RESULTS: Nine case series studies with 443 patients (642 tubes) were included. Population size n = 4 (7 tubes) to n = 210 (320 tubes). All studies were of poor quality and featured a high risk of bias. We found reduction of patient symptoms in ETD questionnaire ($P < .001$), postoperative normalization of the tympanic membrane, conversion of type B or type C into type A tympanograms, reduced mucosal inflammation, increased number of positive Valsalva test and Swallowing tests, improvement in Eustachian tube score, reduction in Sino-Nasal Outcome Test (SNOT)-22 score ($P = .001$), and increased quality of life ($P = .001$). No serious adverse events were found.

CONCLUSION: The evidence of BET is poor and biased. No firm conclusions can be made to identify patients who will benefit from the procedure or to accurately predict surgical results. Randomized controlled trials or case-control trials are needed.

Balloon dilation of eustachian tube



(A) Preoperative 30 degree angled rigid endoscopic view of left eustachian tube nasopharyngeal orifice showing inflamed, edematous mucosa circumferentially and especially at the posterior cushion. The lumen is swollen closed.
(B) Intraoperative inflation of a 7 mm diameter by 16 mm long balloon placed within the cartilaginous eustachian tube.
(C) Immediate postdilation view of the eustachian tube lumen showing some minor mucosal laceration and significant persistent widening of the lumen.

Figures reprinted with permission from: Dennis S Poe, MD, Children's Hospital Boston.

Table 1. Inclusion and Exclusion Criteria.

Participants	Persons eligible for balloon Eustachian tuboplasty with a clinical diagnosis of Eustachian tube dysfunction Exclusion: diagnosis of adenoid tissue, rhinopharyngeal tumors, patoulous tube, cleft palate
Intervention	Balloon dilation Eustachian tuboplasty
Comparators	Any or none
Outcomes	Change in symptoms (severity or frequency), middle ear pathology, eardrum status, Eustachian tube function tests, hearing, adverse events, complications, health-related quality of life
Study design	Any Exclusion: abstracts, publications without peer review

Table 2. Resources Searched.

	No. Hits
PubMed	36
Embase	36
Web of Science (Science Citation Index Expanded & Conference Proceedings Citation Index-Science)	41
Scopus	40
Cochrane Database of Systematic Reviews (SDSR)	1
Cochrane Database of Abstracts of Reviews of Effects (DARE)	0
Cochrane Central Register of Controlled Trials (CENTRAL)	0
Cochrane Methodology Register	0
Health Technology Database	0
NHS Economic Evaluation Database	0
Latin America and Caribbean Health Sciences (LILACS)	0
Others:	
Clinicatrials.gov	0
Controlled-trials.com	1
Clinicaltrialsregister.eu	0
MHRA.gov.uk	0
Fda.gov	0
Who.int/ictrp/en	0

- Balloon dilatation Eustachian tuboplasty(BET) was first described by Ockermann et al in 2010
- The search was limited to results after Jan.2010
- No attempt was made to pool the data for a meta-analysis
- Using the modified Delphi technique quality appraisal tool for case series studies

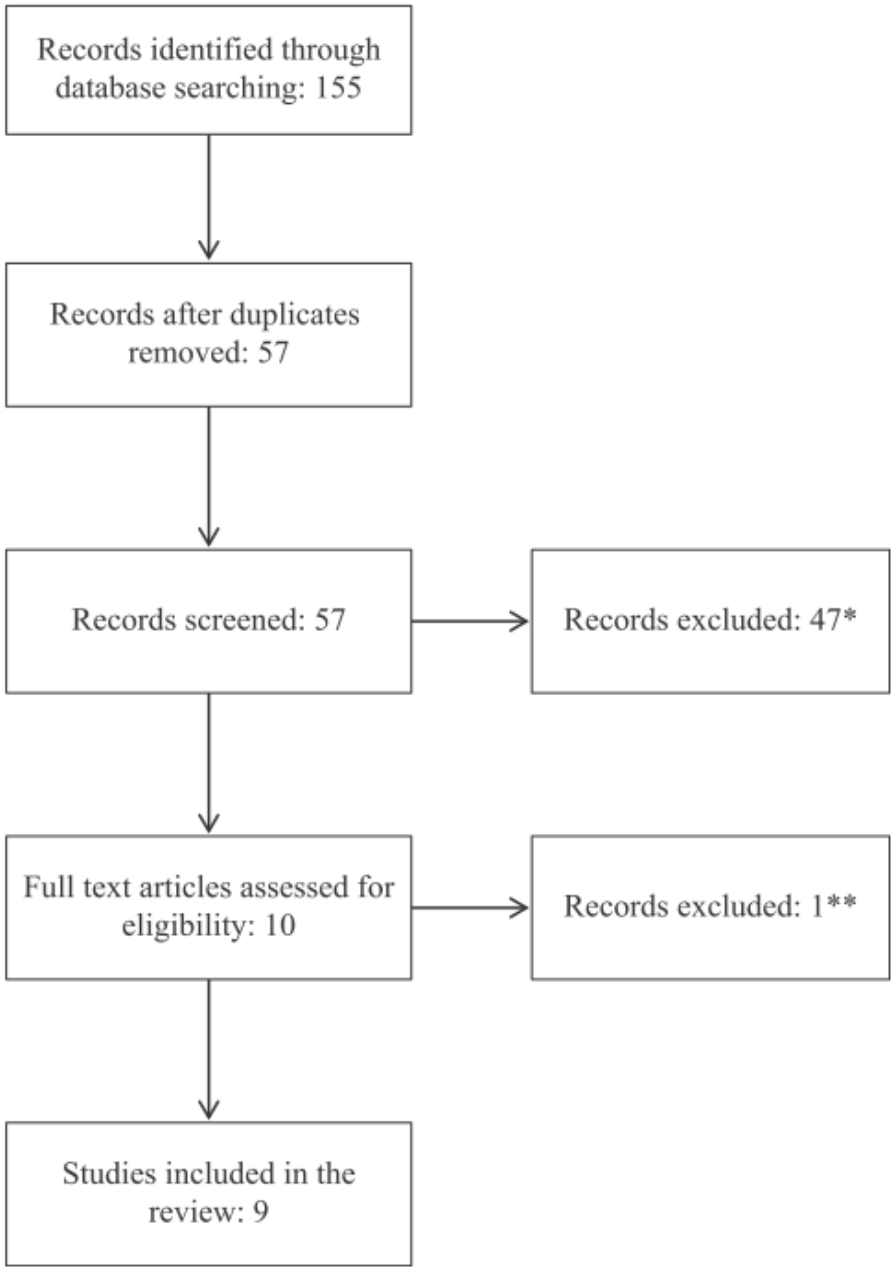


Figure 1. Flow chart of the study selection.
*Reasons for exclusion: records not on subject, conference abstracts.
**Reason for exclusion: no isolated balloon Eustachian tuboplasty results could be extracted.

- Dx: endoscopy, tubomanometry, Swallowing test, CT, ENT exam, audiometry, tympanometry...

Table 3. Overview of Studies.

Study	Design	n	Diagnostics
Ockermann (2010)	Case series	8 (13 tubes)	Rhinopharyngeal endoscopy, otomicroscopy, tubomanometry, Valsalva, Swallowing test, HR-CT of the temporal bone
Poe (2011)	Case series	11 (11 tubes)	Rhinopharyngeal endoscopy, otomicroscopy, tympanometry, HR-CT of the temporal bone, Valsalva
McCoul (2012)	Case series	22 (35 tubes)	ENT exam, pneumatic otoscopy, tympanometry, pure-tone audiometry, CT of the temporal bone
Schröder (2012)	Case series	1 group of 66 (115 tubes) 1 group of 12 (20 tubes)	ENT exam, audiometry, tympanometry, tubomanometry, Valsalva, Swallowing test, CT of the temporal bone
Catalano (2012)	Case series	70 (100 tubes)	Tympanometry
Jurkiewicz (2012)	Case series	4 (7 tubes)	ENT exam, rhinopharyngeal endoscopy, tympanometry, pure-tone audiometry, pressure-swallow test, Valsalva, CT angiography of the carotid artery
Tisch (2013)	Case series	210 (320 tubes)	Valsalva, Toynbee test, subjective evaluation, tympanometry, otomicroscopy
Bast (2014)	Retrospective quality of life questionnaire	30	ENT exam, audiometry, tympanometry, CT of the petrosal bone
Silvola (2014)	Prospective series Some of the patients are follow-up from a pilot study (Poe 2011)	37 (41 tubes)	Rhinopharyngeal endoscopy with systematic mucosal inflammation score, otomicroscopy, tympanometry, HR-CT of the temporal bone, Valsalva

Abbreviation: HR-CT, high-resolution computed tomography.

Table 4. Overview of Studies, Inclusions and Exclusions.

Study	Inclusion (OME, score, history…)	Exclusion (TM joint, tumor, structure…)
Ockermann (2010)	Symptoms of chronic obstructive ETD or recent tympanoplasties caused by acute relapsing OM or chronic OME as a consequence of ETD	N/a
Poe (2011)	Unilateral or bilateral OME for ≥5 consecutive years, broken only by grommet insertion or TM perforation	N/a
McCoul (2012)	Age >18 years, abnormal tympanogram (non-A-curve with admittance <0.2 mmho or resting pressure <−100 daPa, abnormal otosopic examination, symptoms of unilateral or bilateral ETD, failure to improve symptoms by medical therapy over 2 months	Any head and neck surgery within 3 months, history of RT to the head and neck, sinonasal malignancy, acute upper respiratory infections, nasal polyposis, cleft palate, craniofacial syndrome, cystic fibrosis or other immunodeficiency
Schröder (2012)	Tuba score ≤5, anamnestic and clinical signs of ETD	Age < 18 years, tumor of the rhinopharynx, dehiscent bony canal of the carotid artery, severe septal deviation, severe hypertrophy of the nasal turbinates
Catalano (2012)	Adults with a history of chronic ETD symptoms	Temperomandibular joint disease, early hydrops
Jurkiewicz (2012)	Lasting or periodic uni- or bilateral partial hearing loss, feeling of obstruction, clicking noises	N/a
Tisch (2013)	Adult patients with symptoms of ETD and prior failed attempts to treat with medicine or surgery	N/a
Bast (2014)	Chronic ETD	Age <18 years, unidentifiable opening of the ET in the nasopharynx, dehiscence of the bony canal of the carotid artery, septal deviation, hyperplastic turbinates
Silvola (2014)	Unilateral or bilateral persistent OME or significant nonadherent TM ≥5 years and follow-up ≥1, 5 years	Dehiscence of the bony canal of the carotid artery

Abbreviations: ET, Eustachian tube; ETD, Eustachian tube dysfunction; OM, otitis media; OME, otitis media with effusion; RT, radiotherapy; TM, tympanic membrane.

Table 5. Overview of Studies, Methods and Follow-up.

Study	Methods	Follow-up
Ockermann (2010)	Bielefeld balloon system. The catheter was introduced into the cartilaginous and the bony canal of the ET. Inflation to 20 mm length and 3 mm width at 10 bar for 2 minutes	1, 2, and 8 weeks
Poe (2011)	Reliva Solo Sinus Balloon Dilation System, catheter introduced into the cartilaginous part of the ET. Inflation to 12 atm for 1 minute in 7 cases and 8-10 atm for 1 minute in 5 cases 5 patients had adjunctive procedures (2 grommet insertions, 3 grommet removals)	1 and 6 months
McCoul (2012)	Reliva Solo Sinus Balloon Dilation System, catheter (5 × 24 mm^2 [n = 17] or 7 × 24mm^2 [n = 18]) introduced into the cartilaginous part of the ET. Adjunctive surgery: all patients had partial inferior turbinectomy; 15 submucosal resection of the nasal septum, 12 sphenoethmoidectomy with maxillary sinostomy, 2 revision ethmoidectomy, 1 grommet inserted, 1 myringoplasty	3, 6, 12 weeks and 6 months
Schröder (2012)	Bielefeld Balloon System, dilation of the cartilaginous part of the ET; 6 patients had adjunctive surgery of paranasal sinuses, nasal septum, or turbinates	
Catalano (2012)	Relieva Vortex Sinus Irrigation Catheter introduced into the cartilaginous part of the ET 44 patients had BET under GA (no specified pressure or time of dilation) 5 had adjunctive otologic surgery, 39 sinonasal surgery 26 patients had BET under LA in office setting. n = 5 tolerated only 6 atm dilation, n = 20 8 atm for 10 seconds, n = 22 8 atm for 30 seconds	
Jurkiewicz (2012)	Bielefeld Balloon System, dilation of the cartilaginous part of the ET	6 weeks
Tisch (2013)	Bielefeld Balloon System, dilation of the cartilaginous part of the ET	N/a
Bast (2014)	Bielefeld Balloon System, dilation of the cartilaginous part of the ET	6-18 months
Silvola (2014)	Reliva Solo Sinus Balloon Dilation System, catheter introduced into the cartilaginous part of the ET, 12 atm for 1 minute (15 patients from the pilot) 12 atm for 1 minute, then deflation and redilation 12 atm 1 minute (26 patients) All patients instructed to do Valsalva ≥2 times a day for 1 week after surgery	1,5 years

Three different instruments are in use:

1. Bielefeld Balloon System (Spiggle & Theiss, Overath, Germany) (length 20 mm, diameter 3.28 mm)
2. Reliva Solo Sinus Balloon Dilation System (length 16 mm, diameter 7 mm)
3. Reliva Vortex Sinus Irrigation Catheter (length 16 mm diameter 5 mm) (Acclarent, Inc, Menlo Park, California, USA).

Table 6. Overview of Studies, Results and Complications.

Study	Results	Complications
Ockermann (2010)	Significant improvement in ETS at all follow-up examinations Pre-BET mean ETS = 1.077, week 1 = 4.154, week 2 = 5.846, week 8 = 7.539 Pre-BET swallowing test = 12 never, 1 infrequent; week 8 = 1 never, 6 infrequent, 5 always Pre-BET Valsalva = 9 never, 2 infrequent, 1 always; week 8 = 1 never, 6 infrequent, 5 always	None
Poe (2011)	TM status recovered to normal in 2/4 with preoperative intact TM, the 2 remaining had grommets inserted when seen at follow-up. Tympanometry measured, but results are inconclusive due to perforations and grommets. Mucosal inflammation was reduced from a mean of 2.91 (0.83) to 1.73 (no SD available) no *P* value reported. Preoperative Valsalva = 11 never; 6 month = 11 always	Mucosal tear n = 5, C6-7 contralateral radiculopathy due to neck extension in 1 patient
McCoul (2012)	Pre-BET TM status: 33 TM showed retraction (4 with OME, 1 with early attic cholesteatoma), 1 had a grommet, and 1 had a stable TM perforation Post-BET TM status: 35 free of retraction, 1 ear had a resolving perforation from grommet insertion Pre-BET tympanometry: type C = 20, type B = 5, type A = 10. Post-BET tympanometry: type A = 34, type B = 1 (perforated) Mean ETDQ-7 scores improved significantly at all follow-up visits. Mean SNOT-22 scores improved significantly at all follow-up visits.	n = 1 bleeding from the turbinectomy site on day 3 resulting in bilateral haematotympanon, myringotomy was required
Schröder (2012)	Significant improvement after 2 months in tuba score by ≥2 points in 60%, 1-2 points in 19%, and no change in 21% from a subgroup of 66 patients (115 tubes) The first 20 patients were followed 12 months; 12 were available for follow-up; in this subgroup the tubas core was improved by ≥2 points in 10 patients and 1-2 points in 2 patients	2 reports of self-limiting enhancement of known tinnitus, 1 self-limiting epistaxis
Catalano (2012)	Pre-BET tympanometry: abnormal (type B or C) in 28 ears, post-BET improvement (type A) in 25 of the 28 Overall 71% patients showed notable improvement or reduction in symptoms (no information of specific endpoints included),	1 preauricular emphysema, resolved spontaneously
Jurkiewicz (2012)	Pre-BET tympanometry: abnormal (type B or C) in 7 ears, post-BET improvement (type A) in 6 of the 7 Pre-BET Valsalva positive in 1/7 ears, post-BET Valsalva positive in 6/7 ears Pre-BET PST negative in 7/7 ears, post-BET PST positive in 7/7 ears Otoscopic examination pre-BET 7/7 TM retraction, post-BET otoscopic examination 5/7 TM normal, 2/7 no change	None
Tisch (2013)	Post-BET patient report of symptoms: 150 a lot better or completely resolved, 35 better, 25 no change Valsalva pre-BET was negative in 92%, post-BET in 10%	10 cases of minor epistaxis, 1 case of emphysema in the face, neck and mediastinum
Bast (2014)	Significant improvement in total score ($P = .001$) and subscores general health ($P = .001$) and physical health ($P = .039$) in GBI	N/a
Silvola (2014)	TM status: pre-BET 41/41 abnormal, post-BET 37/41 normal OME: pre-BET 38/41, post-BET 1 Retraction/atelectasis: pre-BET 3/41, post-BET 3/41 Tubal inflammation was reduced from 2.8 to 1.4 ($P < .001$) Tympanometry: pre-BET type A = 1, type B or C = 16 perforation or grommet 24; post-BET: type A = 23, type B = 0, type C = 6 perforation or grommet 12 Valsalva pre-BET was negative in 100%, post-BET in 20%	None

Outcome and follow up

- Tisch et al and Catalano et al. : Increased satisfaction of subjective outcome
- McCoul and Anand: positive change in mean score of ETDQ-7(4.5->2.8) at 6 months
- Tympanometry show a high rate of conversion of type B or C into type A when follow-up.(6wk-1.5y)
- Mucosal inflammation at the tubal orifice improved at 6 months and 1.5 years
- Bast et al: QoL improved

Table 7. Study Quality.

	Ockermann	Poe	McCoul	Schröder	Catalano	Jurkiewicz	Tisch	Bast	Silviola
Hypothesis stated?	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes	Yes	Yes
Participants described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inclusion and exclusion criteria?	Partial	Partial	Yes	Yes	Yes	Partial	Partial	Yes	Yes
Consecutive recruitment?	No	Unclear	Yes	Unclear	Unclear	Unclear	Unclear	Yes	Yes
Inclusion at similar point in the disease?	No	No	Unclear	No	Unclear	No	No	No	Yes
Procedure described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Co-interventions reported?	No	Unclear	Unclear	No	Unclear	No	No	No	Unclear
Outcomes clearly defined?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Outcomes appropriately measured?	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Outcomes measured before and after?	Yes	Yes	Yes	Yes	No	Yes	Yes	Not relevant	Yes
Appropriate statistical tests?	Not relevant	Yes	Yes	Yes	Unclear	Not relevant	No	Yes	Yes
Follow-up reported?	Yes	Yes	Yes	Yes	Yes	Yes	Not relevant	Yes	Yes
Loss to follow-up reported?	Not relevant	Not relevant	Yes	Yes	Yes	Not relevant	Not relevant	Yes	Yes
Variability in outcomes reported?	Yes	Yes	Yes	Yes	No	Not relevant	No	Yes	Yes
Adverse events reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Conclusion supported by results?	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No
Conflict of interest reported?	Yes	Yes	Partial	Yes	Partial	Partial	Unclear	Yes	Yes
Prospective study?	Yes	Unclear	Yes	Unclear	Unclear	Unclear	Unclear	No	Yes

The assessment of quality guided by modified Delphi technique quality tool for case series studies is listed in this table.

The overall quality of all the included studies is pool.

Discussion

- The underlying mechanism has not yet been identified, but it is hypothesized that submucosal microhemorrhages from the applied pressure cause fibrosis and expansion of the internal ET diameter during healing.
- Preopera-tive CT scan of the temporal bone and the exclusion of patients with a bony dehiscence or petrous aneurysms.
- Use EDTQ-7(>2.1), Valsalva's test and Tubomanometry for evaluation of outcome.

Laryngoscope. 2012 May;122(5):1137-41. doi: 10.1002/lary.23223. Epub 2012 Feb 28.

Validating the clinical assessment of eustachian tube dysfunction: The Eustachian Tube Dysfunction Questionnaire (ETDQ-7).

McCoul ED[1], Anand VK, Christos PJ.

Author information

Abstract

OBJECTIVES/HYPOTHESIS: Eustachian tube dysfunction (ETD) is a common condition that is associated with otologic and rhinologic symptoms. The complete assessment of ETD is limited without a valid symptom score. We developed and conducted initial validation of the seven-item Eustachian Tube Dysfunction Questionnaire (ETDQ-7), a disease-specific instrument to assess symptoms with respect to ETD.

STUDY DESIGN: Validation study.

METHODS: The ETDQ-7 was developed using standard survey methodology. The ETDQ-7 was completed by a group of 50 consecutive adult patients diagnosed with ETD and 25 non-ETD patients who served as a control group. Tympanometry was used as a criterion standard to distinguish the two groups. A subset of respondents repeated the ETDQ-7 at a time point 4 weeks later.

RESULTS: Content validity for the ETDQ-7 was established by focus group and review of the literature. Reliability testing indicated acceptable internal consistency for the entire instrument (Cronbach $\alpha = .71$). The test-retest reliability indicated good correlation between the two questionnaires completed by the same patient 4 weeks apart ($r = 0.78$). The ETDQ-7 was able to discriminate between patients with ETD and those without ($P < .001$), indicating excellent discriminant validity.

CONCLUSIONS: The ETDQ-7 is a valid and reliable symptom score for use in adult patients with ETD that may facilitate clinical practice by highlighting the impact of ETD. Further testing is needed to determine its usefulness in assessing treatment response.

TABLE I.
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. Crackling 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

Conclusion

- First systemic review to describe the evidence for BET.
- No RCTs, or case-control studies on BET were identified.
- Poor study design: no absolute indication, no accurate prediction of results.
- To establish consensus of diagnostic criteria is important.
- → the evidence of BET is poor and biased.
- → No firm conclusions can be made to identify patients who will be benefit from the procedure or to accurately predict surgical results.

Treatment for Patulous dysfunction

- Treatment should be directed at underlying medical condition, if known
- Weight gain is rarely effective and not recommended unless underweight
- Decongestants or nasal steroid ate not effective and may worsen symptoms
- Reassurance about the benign nature
- Medical therapy should be initiated if severe s/s lasting for more than 6 weeks

Medical management for Patulous dysfunction

- Good hydration +/- nasal saline drops as needed
- Thickening the mucus can be attempted using potassium iodine eight to ten drops in a glass of juice orally 3 times daily

Dyer RK Jr, McElveen JT Jr et al. *The patulous eustachian tube: management options* Otolaryngol Head Neck Surg. 1991 Dec;105(6):832-5

Surgical management for Patulous dysfunction

- Tympanostomy tube insertion:
- first-line surgical treatment (only effective in relieving the bothersome sensation of movements of the tympanic membrane during breathing, not autophony)
- Intraluminal catheter placement:
- An intravenous catheter sealed with bone wax is a method to block the wide eustachian tube by plugging its lumen
- Cartilage grafting:
- after failure of intraluminal catheters
- Endoscopic approaches are used for reconstruction of the patulous defect while preserving the eustachian tube's function. The technique implants conchal or septal cartilage grafts to augment the concave defect within the anterolateral wall.
- Complete occlusion of the eustachian tube + VT

Systematic Review

Surgical Management of Patulous Eustachian Tube: A Systematic Review

1960-2014

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Objectives: Patulous Eustachian tube (PET) is a challenging clinical problem with limited medical and surgical options. The current study systematically reviews the literature to determine the safety and efficacy of surgical treatments for PET.

Data Sources: Medline, Google Scholar, and Cochrane databases.

Methods: Studies evaluating the surgical management of PET were extracted based on defined inclusion criteria. Data including surgical techniques, outcomes, and complications were extracted and analyzed.

Results: A total of 1,616 studies were retrieved from the initial search. Of these, 14 studies comprising a total of 226 patients (253 sides) met inclusion criteria and were evaluated for surgical techniques, patient outcomes, and complications. As defined by the Oxford Center for Evidence-Based Medicine (Oxford, UK), all studies were classified as level 4 evidence. The most commonly reported techniques were ET plugging (3 studies), PE tube placement (2 studies), and suture ligation (2 studies). Postoperative follow-up ranged from 2 to 60 months (mean, 20.6 months). Outcome measures varied significantly between individual studies, with overall symptom improvement reported between 22% and 100% (mean 72.4%; 95% CI, 62.5%–81.2%). A low incidence of minor complications was reported in nine of 14 studies.

Conclusions: Current literature evaluating the surgical management of PET is limited and comprised entirely of level 4 studies. Comparisons between techniques were not possible due to the small number of studies and variable outcome measures. Future larger studies evaluating defined outcomes and quality-of-life measures are needed to determine the comparative efficacy of surgical treatments for this challenging condition.

Key Words: Patulous eustachian tube, eustachian tube dysfunction, autophony, eustachian, patulous, outcomes, surgery.

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Laryngoscope. 2015 Feb 3. doi: 10.1002/lary.25168

Introduction

- Standardized treatment algorithms have yet to be established.
- Treatment aim to narrow or close the ET pharyngeal orifice.
- Nonsurgical methods: weight gain, topical estrogen, and insufflation with boric or salicylic acid.
- Surgical method: injection of bulking agents, fat/cartilage plugging, ligation of the orifice, endoluminal cauterization, and hamulotomy.

Arch Otolaryngol. 1982 Nov;108(11):735-9.

Surgical treatment of patulous eustachian tube.

Virtanen H, Palva T.

Abstract

Thirteen patients (16 ears) with patulous eustachian tubes were treated with pterygoid hamulotomy combined with transposition (eight ears) or transection (eight ears) of the tendon of the tensor veli palatini muscle. Tubal function was tested preoperatively and postoperatively by sonotubometry. Prior to surgery, only one ear showed normal tubal function on swallowing at the time of the test. The follow-up period ranged from two months to five years. Nine ears yielded normal sonotubometric results during the average follow-up time of two years, while two tubes opened on swallowing, remained open for some time, and closed little by little. The remaining five tubes stayed continuously open as before surgery, and tubal symptoms were unaltered. Transection operation had been performed on two of these ears and transposition on three. The transposition or transection procedure can be used as a routine procedure for correction of patulous tubes. Good results can be expected in about 70% of cases.

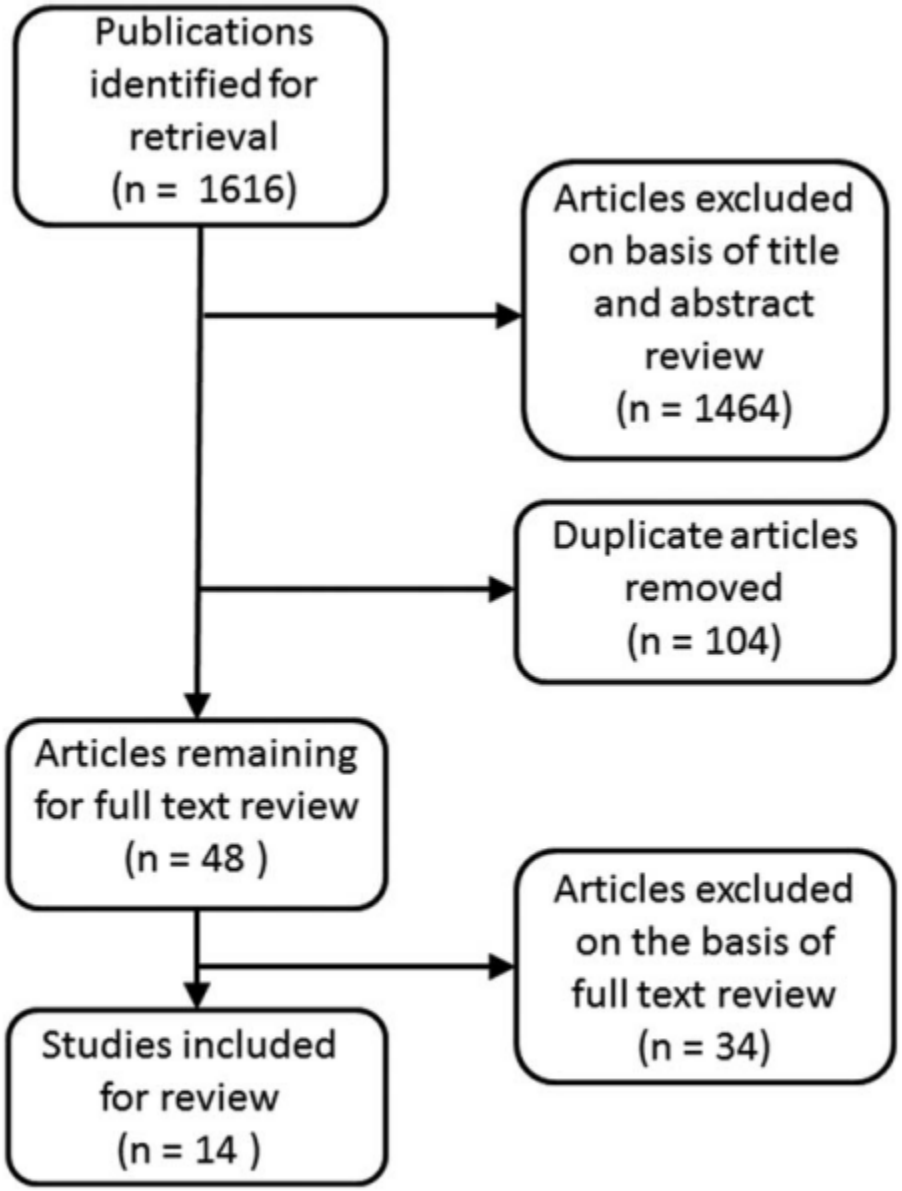

Fig. 1. Article selection process for systemic literature search.

TABLE I.
Characteristics and Outcomes of Included Studies.

Overall symptoms improvement: 22-100%

Study	Patients (Sides)	Procedure	F/U, Months	Outcome Measures	% Improved
Vaezeafshar 2014	14 (23)	Endoscopic endonasal injection of hydroxyapatite	17.5 (9–36)	Subjective improvement (complete/significant/unchanged/worse) - autophony, fullness, popping/clicking, pain, vertigo	59
Rotenberg 2013	11 (14)	Endoscopic endonasal multilayer closure (fat plugging, endoluminal cauterization, suture ligation)	6	Autophony score, Postoperative audiometry	86
Ikeda 2011	14 (19)	Ventilation tube placement and/or myrigotomy with ET plugging	NS	Improvement in habitual sniffing	89
Poe 2007	11 (14)	Endoscopic transnasal/transoral reconstruction of ET with autologous cartilage or alloderm	15.8 (3–30)	Subjective improvement in autophony (complete/significant/unchanged/worse)	93
Takano 2007	10 (15)	Endoscopic transnasal/transoral ligation of eustachian tube	13–27	Symptom resolution and sonotubometry	60
Sato 2005	35 (42)	Trans-tympanic insertion of silicone plug	38.9 (6–68)	Symptom resolution, sonotubometry and tubotympanoaerodynamography	71
Dyer 1991	4 (4)	Trans-tympanic ET occlusion via catheter with ventilation tube	NS	Symptom resolution	100
Chen 1990	46 (60)	Ventilation tube placement	NS	Symptom resolution	53
Robinson 1989	8 (9)	ET diathermy	15.9 (3–36)	Symptom resolution	22
O'Connor 1981	7 (9)	ET cauterization with silver nitrate	NS	Symptom resolution	78
Bluestone 1981	4 (4)	Trans-tympanic ET occlusion via catheter with ventilation tube	Up to 36 months	Symptom resolution	100
Virtanen 1982	13 (16)	Pterygoid hamulotomy with transposition or transection of tensor veli palatini tendon	24	Symptom resolution and sonotubometry	69
Ogawa 1976	16 (22)	Transnasal infusion of gelatin sponge into ET	NS	Symptom resolution	73
Stroud 1974	3 (3)	Transpalatal transposition of tensor veli palatini	NS	Symptom resolution	100

ET = eustachian tube; F/U = followup; N/S = not specified.

outcome

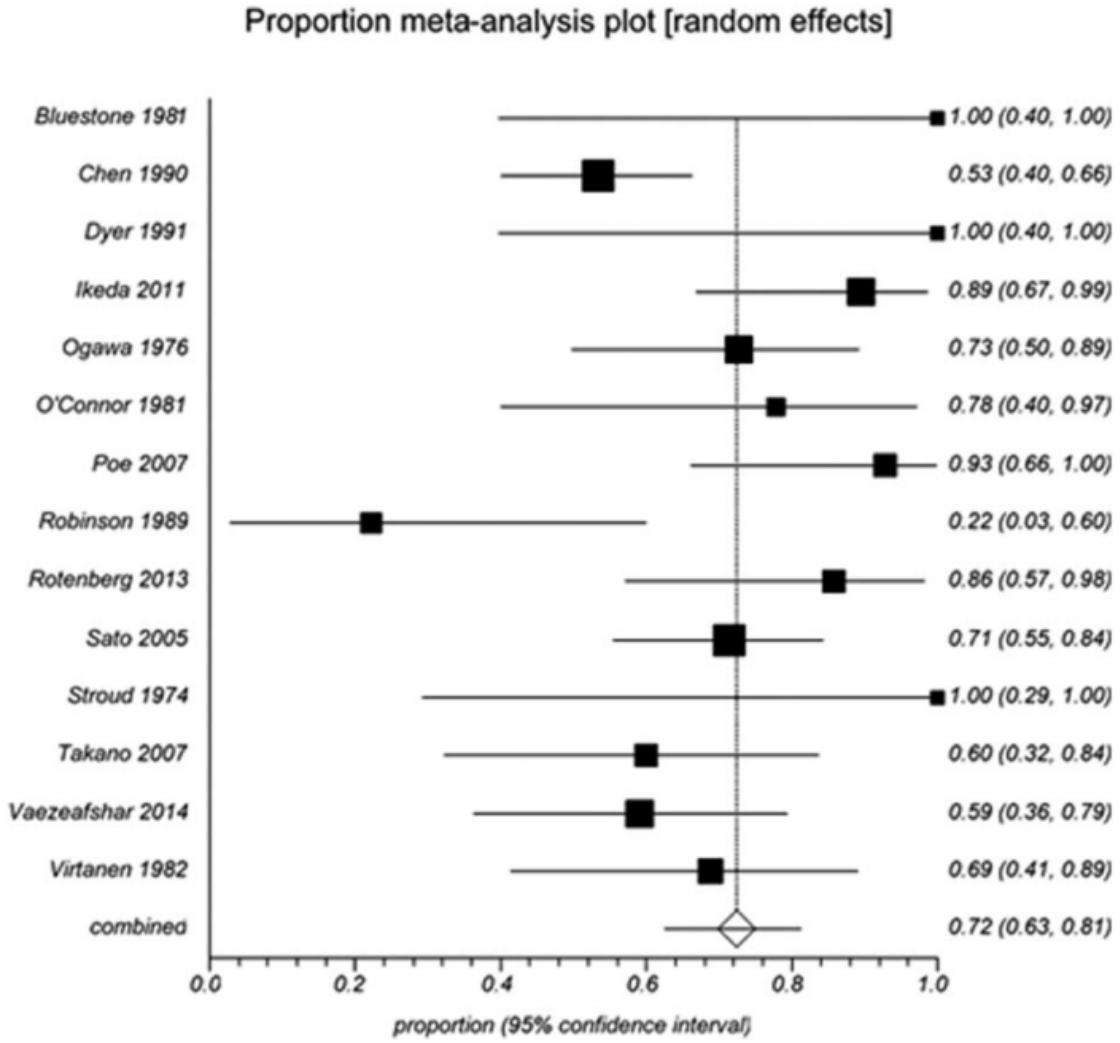

Fig. 2. Forest plot for the success rate (% of patients with improvement in symptoms) of patulous Eustachian tube surgery.

Discussion

- Patulous E-tube is a fairly rare but often frustrating clinical entity for both patient and practitioner.
- Base on this review, most surgical techniques appear to be moderately effective at addressing PE symptoms and improving patient quality of life.
- Narrow margin between symptom relief and pathologic occlusion of the E-tube.
- Limitation: lack of validated metrics and diagnostic criteria in most studies.
- First review of surgical techniques for the management of PET.
- No single technique has been found to be superior in either surgical outcomes or safety.
- To offer interventions based on experience, personal skillset and patient wishes.

Conclusion

- Difficult to treat both medically and surgically.
- Surgical intervention appears to be a safe treatment modality with moderately successful treatment outcomes.

Take home message

- No well-accepted definition of eustachian tube dysfunction.
- Clinical diagnosis, mainly base on history and physical examination.
- Dilatory dysfunction or patulous dysfunction
- Treat directed at the underlying etiology, if known.
- Treat medically at first and then surgically.
- Surgical intervention may relieve the symptoms witohout evidence base.

Thanks for your attention!