



# Patulous E-tube

報告人：趙勻廷 醫師

指導者：黃啟原 醫師

廖文輝 醫師

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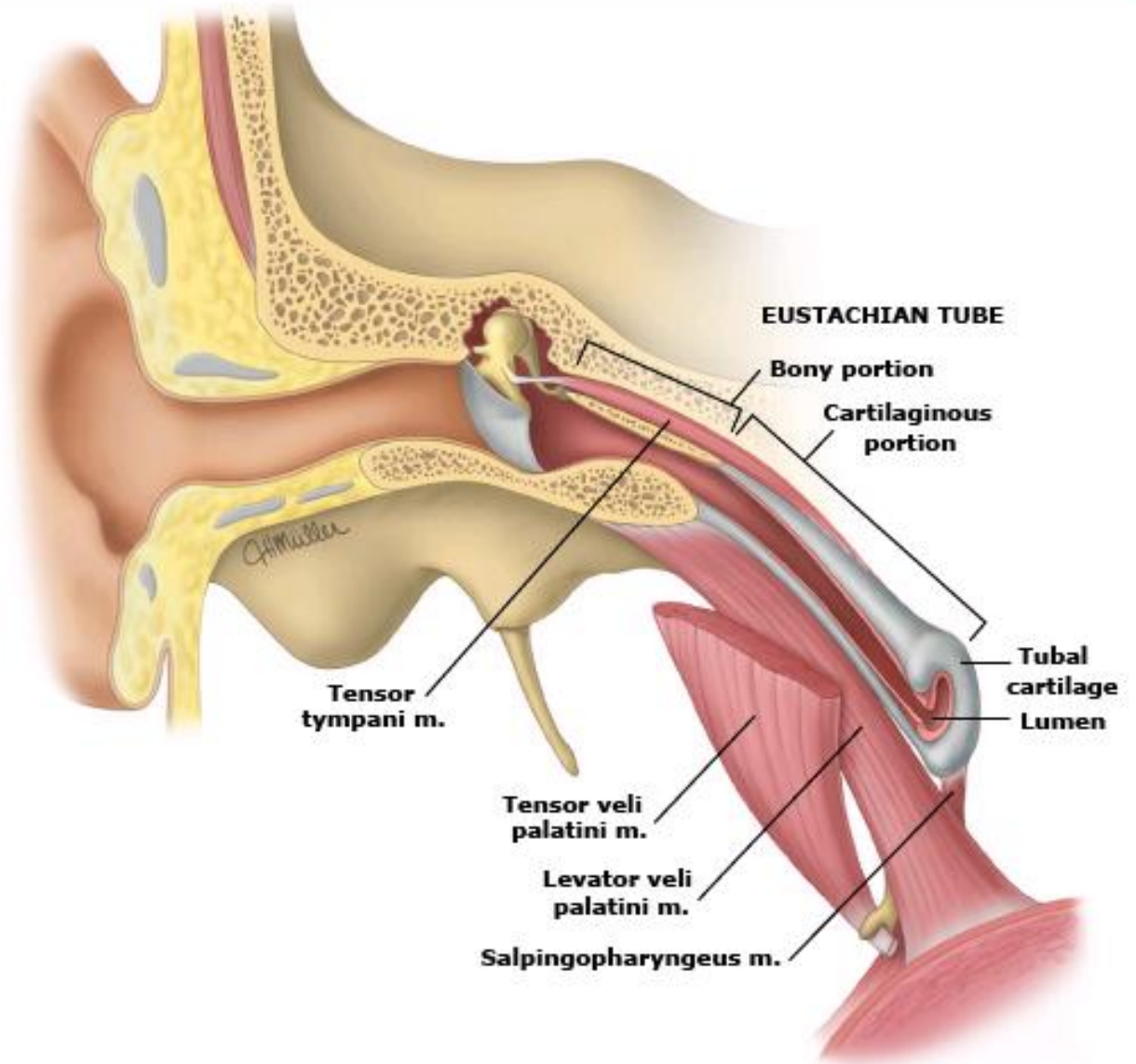
# History

- 🍃 *Almaceon of Sparta(400 B.C):* first description of the structure
- 🍃 *Bartolomeo Eustachi (1563):* tuba auditiva
- 🍃 *Antonio Maria Valsalva (1704):* Eustachian Tube
- 🍃 *Toynbee (1853):* E tube closed at rest normally
- 🍃 *Politzer(1861):* E tube-middle ear disease
- 🍃 *Schwartz (1864):* a scarred ear drum moved synchronously with the breathing.
- 🍃 *Jago (1867):* himself had right-sided patulous tube trouble, symptoms disappear after increasing body weight

# Anatomy of Eustachian tube

- ✦ Length: 30 - 40mm ; osseous: cartilaginous= 1:2
- ✦ 30-40° to the transverse plane; 45° to the sagittal plane
- ✦ Relation to: torus tubarius, Rosenmüller fossa, adenoid

## Anatomy of the eustachian tube




# Anatomy

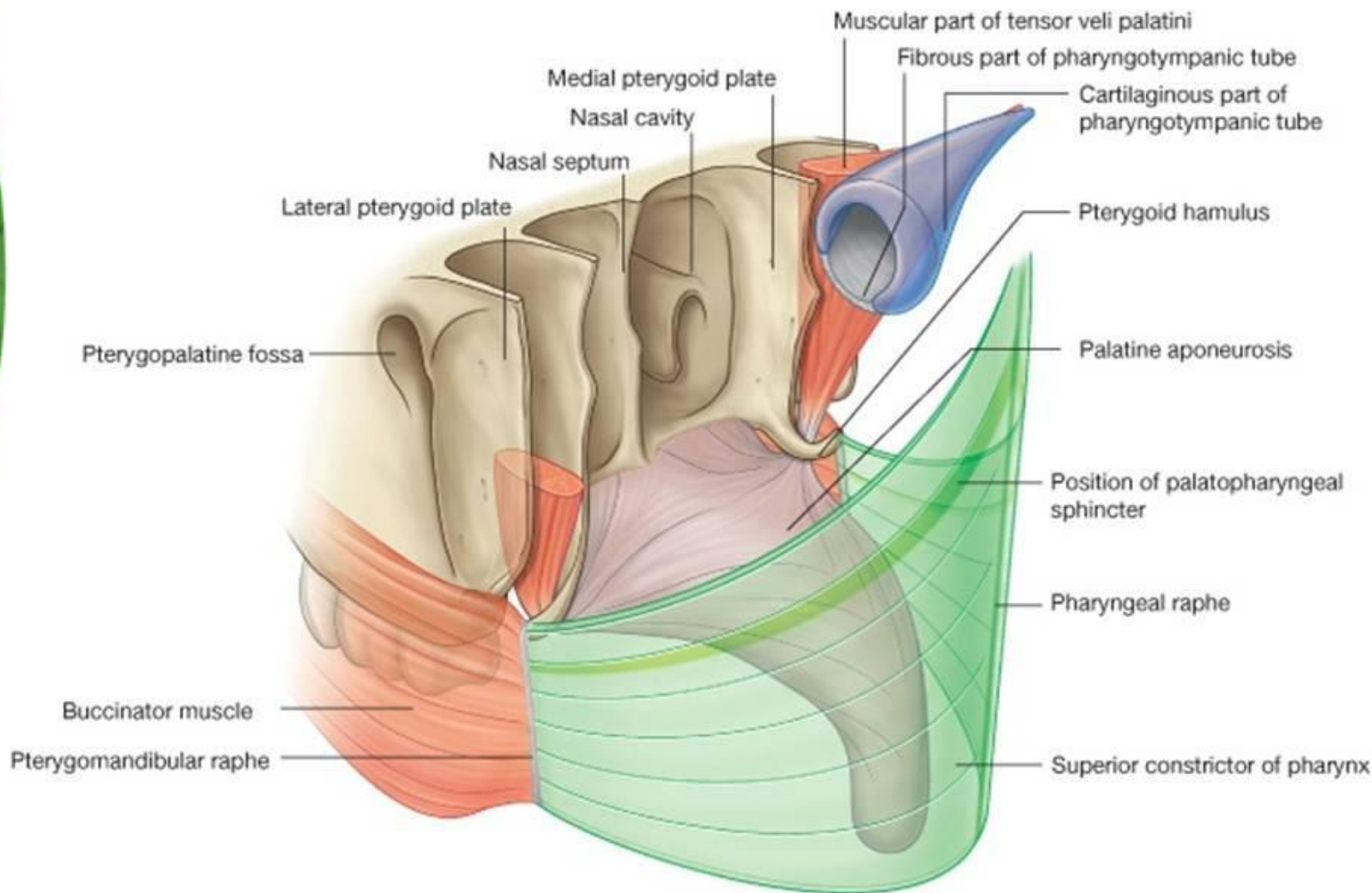
## Associated muscles:

- ✦ tensor veli palatini muscle (TVP)
- ✦ levator veli palatini muscle (LVP)
- ✦ salpingopharyngeus
- ✦ tensor tympani

## Tensor veli palatini muscle (TVP):

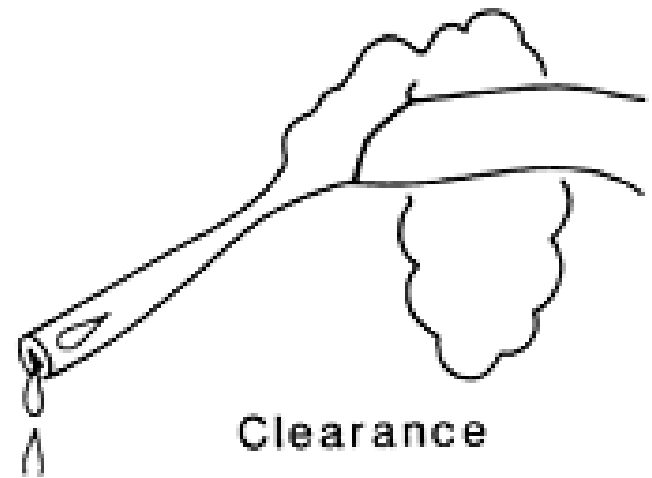
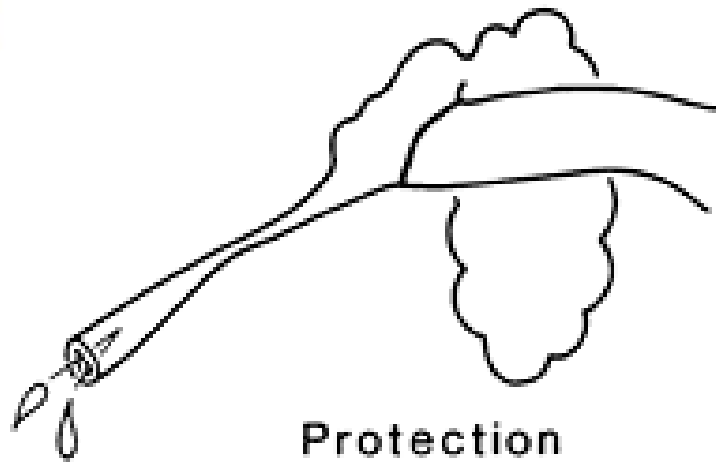
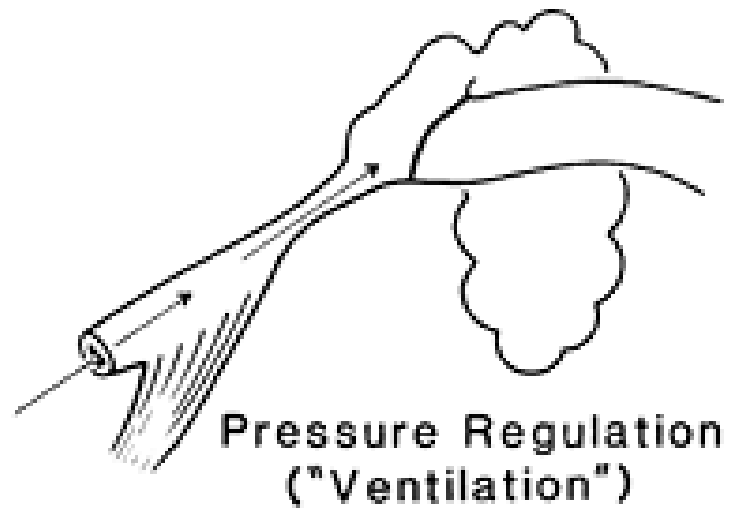
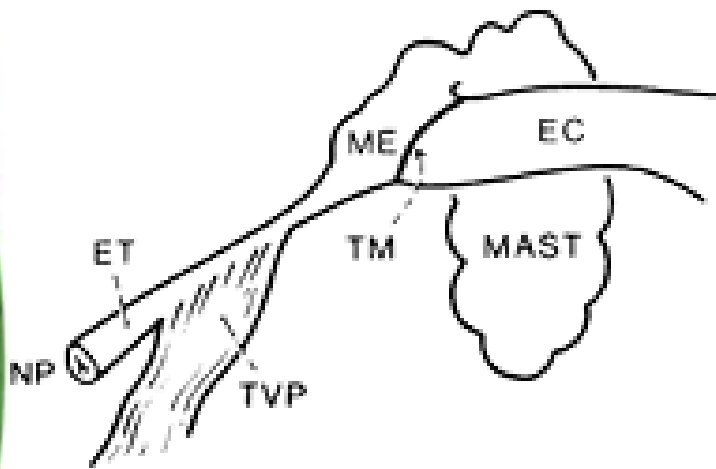
- ✦ **lateral bundles:** scaphoid fossa- Pterygoid hamulus-velum
- ✦ **medial bundle:** tensor tympani + tubal cartilage- velum  
(Dilator tubae)

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



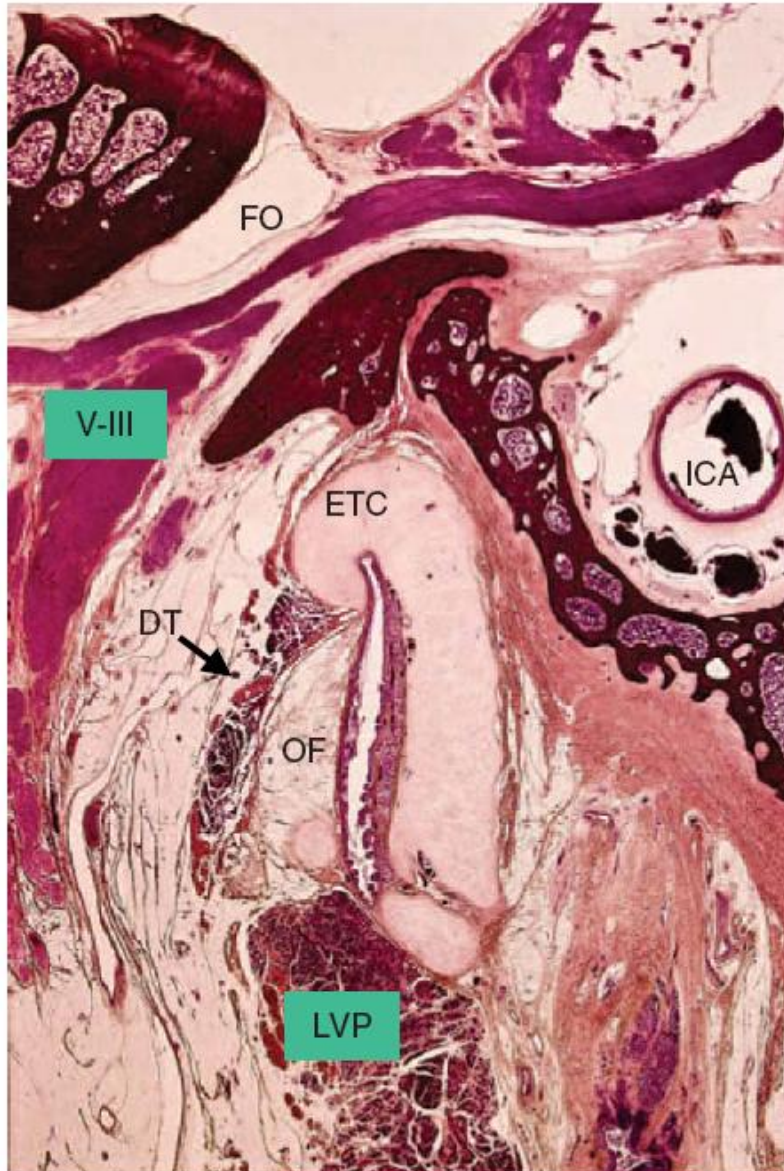
# Physiology of E tube

- 🍃 Functions: pressure regulation, protection, clearance
- 🍃 Function at the cartilaginous part, persistent open in bony portion
- 🍃 Closure: intrinsic elasticity, surface tension of moist mucosa, extraluminal tissue pressure (**Ostmann's fat pad**).
- 🍃 Opening: Tensor veli palatini: major






# Ostmann's fat pad






# Tubal valve

 Closure of the tube is maintained by

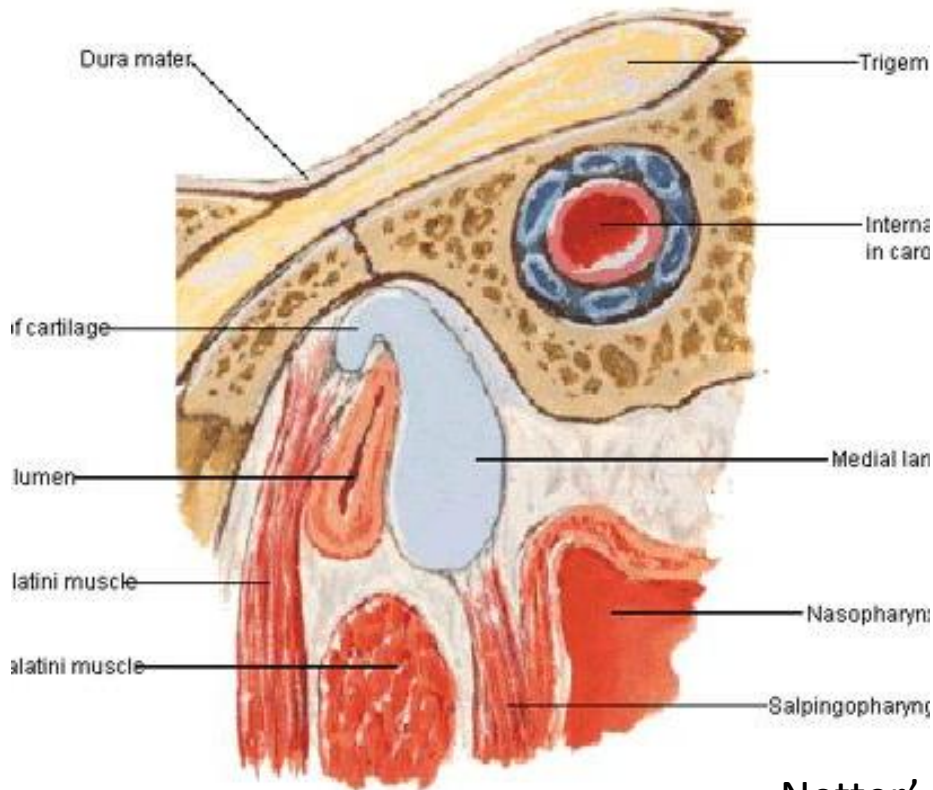
-  A valve-like function of the opposing mucosal surfaces, submucosal tissue, fat, muscle, and cartilage.

 The valve measures

-  approximately 5 mm in length
-  lies within the cartilaginous portion of the ET
-  located about 10 mm distal into the tube from the torus tubarius

## Auditory Tube - Section through Cartilage

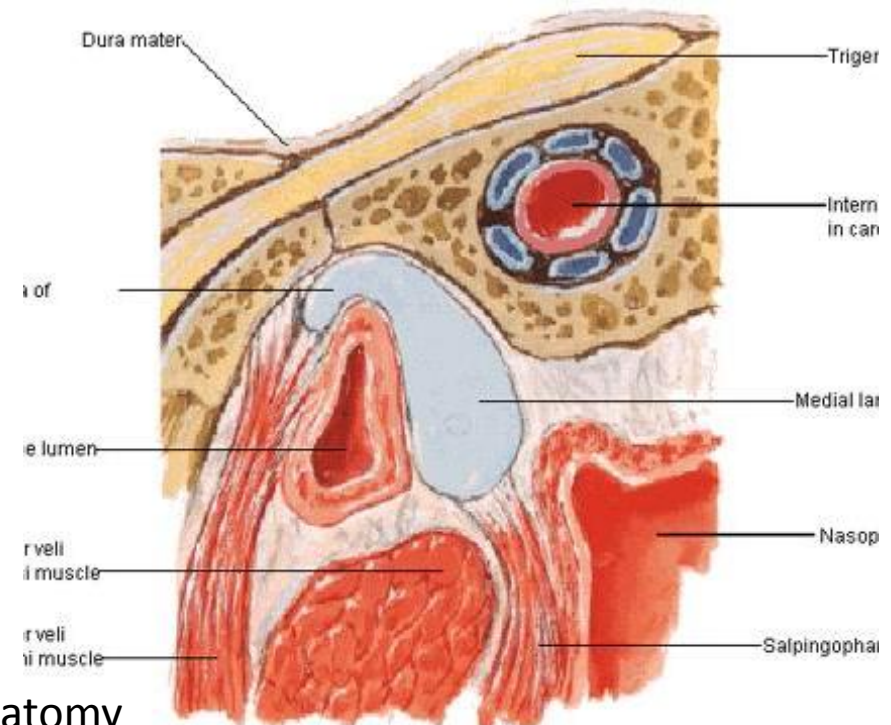
Tube Closed



Auditory tube closed by elastic recoil of cartilage, tissue turgidity and tension of salpingopharyngeus muscles

## Auditory Tube - Section through Cartilage

Tube Open



Lumen opened chiefly when attachment of tensor veli palatini muscle pulls wall of tube laterally during swallowing

Netter' anatomy

# Etiology of patulous E tube

- 🍃 0.3-6.6%, F>M, adults
- 🍃 Most: idiopathic **(1/3)**
- 🍃 Acute weight loss: reduced tissue pressure
- 🍃 Pregnancy: estrogen → PGE → surfactant increase
- 🍃 Hormone therapy:
  - ✦ Contraceptive pills in female
  - ✦ Diethylstilbestrol (DES) treatment of prostatic cancer
- 🍃 Head injury, stress, fatigue

# Etiology of patulous E tube (2)

- 🍃 Neurological disorder: CVA, MS, motor neuron disease, and resection of CNV neuralgia
- 🍃 Drugs: diuretics, nasal decongestants
- 🍃 Allergic rhinitis
- 🍃 Sniff/ Valsalva habit
- 🍃 Atrophy or scarring of NP or musculature:  
Adenoidectomy (*Bluestone 1975*), tonsillectomy, radiotherapy (10 year after NPC: atrophy)
- 🍃 Hemodialysis: *Tetsuaki 2007* lost excess water during HD  
→ reduce the extramural pressure

# Clinical manifestations

- 🍃 Aural fullness, plugged ear, blocked ear  
Roaring tinnitus, synchronized with nasal respiration
- 🍃 Distorted **autophony**
- 🍃 Tympanophony: hear own breath sounds
- 🍃 Mild vestibular symptoms: unsteady, not rotatory  
(excessive pressure changes to occur in the middle ear → inner ear)

# Clinical manifestations (2)

## Relieving factors

- ✦ In supine position or recumbent position: pterygoid plexus venous stasis
- ✦ Nasopharynx congestion or during URI

## Local findings:

- ✦ Drum movement synchronously with respiration when sitting, especially forced respiration in one nostril
- ✦ Disappearance of movement when supine

# Evaluation Tympanogram

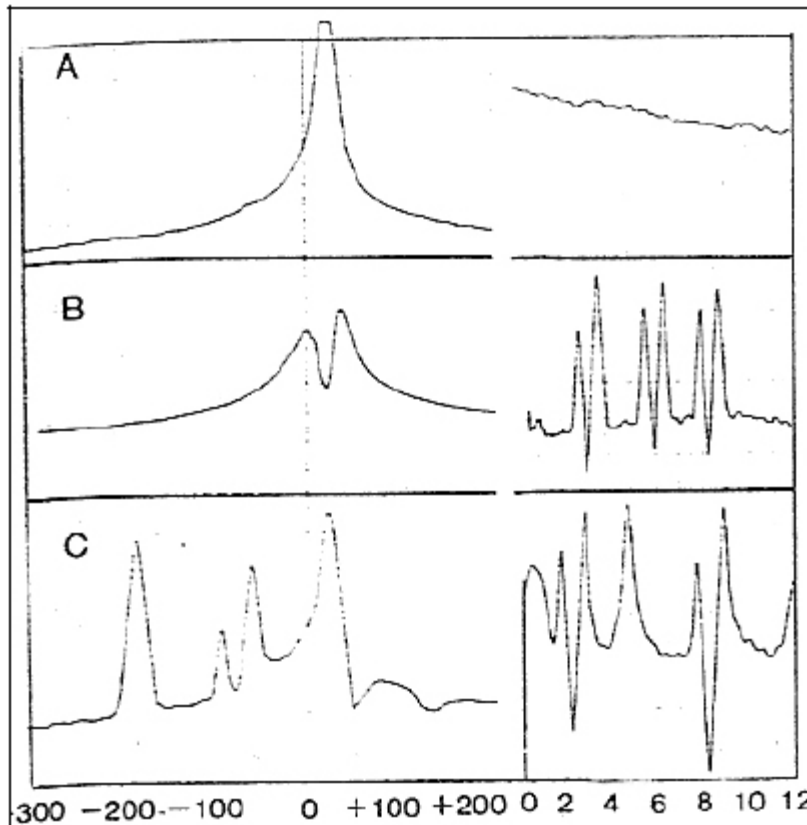


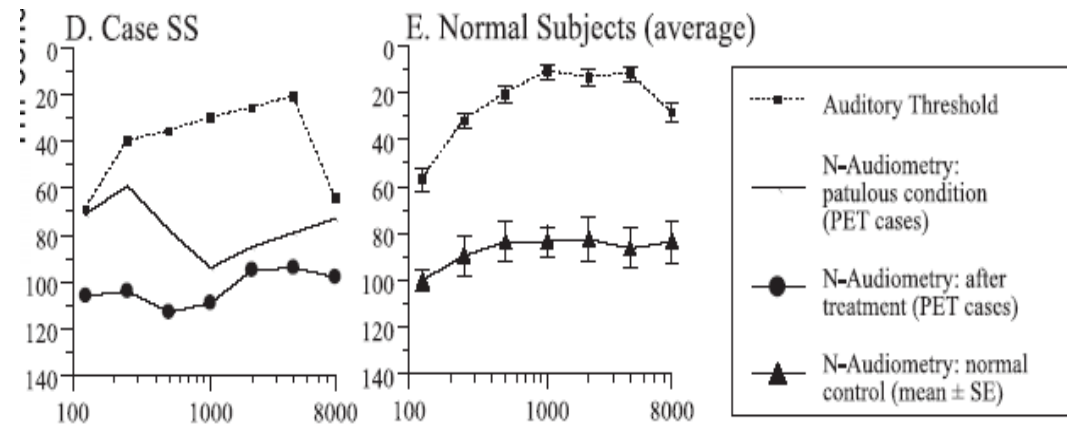
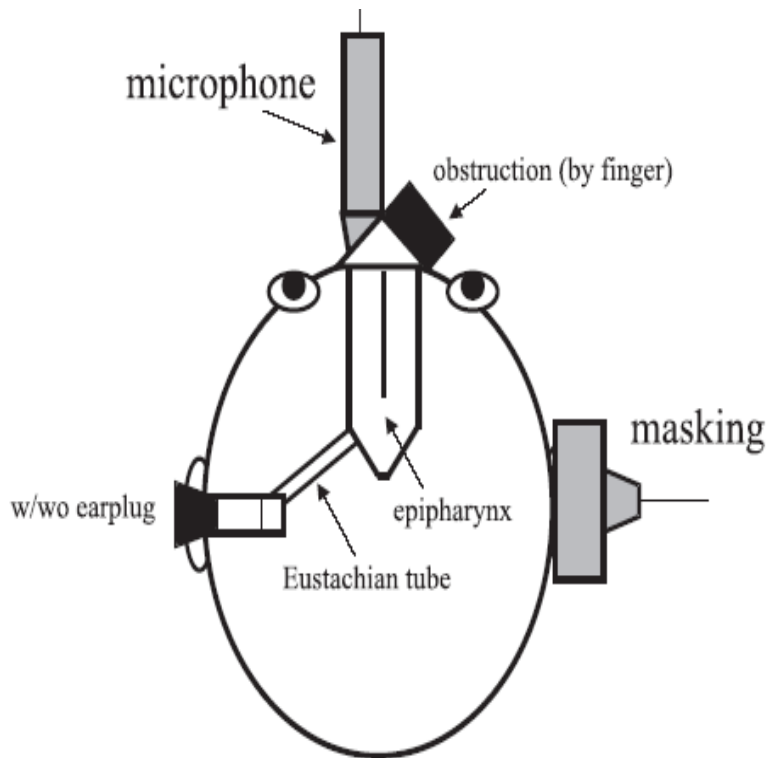
Fig 6.—Patient 4 tested by tympanometry on left and acoustic reflex mode on right. A Patient holds his breath; B, normal; and C forced nasal breathing.

Finkelstein Y, et al.:An objective method for evaluation of the patulous Eustachian tube by using the middle ear analyzer. Arch Otolaryngol Head Neck Surg 1988;114:1134-1138



# Evaluation

## Pure tone in nasal cavity



Possible New Assessment of Patulous Eustachian Tube Function- Audiometry for tones presented in the nasal cavity

*Acta Oto-Laryngologica*, 124:4, 431-435, 2004

Fig. 1. Schematic diagram of the N-audiometric set-up.

# Treatment

## Physical Treatment

- ★ Removal of possible causative etiology

Ex: hearty meal, weight gain, avoid diuretics

- ★ Recline or lower head when symptoms occur
- ★ Lying down with legs raised

# Treatment

## Medical therapy

- ✧ Discontinuation of decongestant and nasal steroid spray.
- ✧ **SSKI** (saturated solution of potassium iodide): for mucous thickening
- ✧ Topical irritant to induce mucosal edema
- ✧ Premarin (estrogen) nasal spray: (25mg in 30 ml N/S): 3 drops tid

# Treatment

## Surgical therapy

- ★ **Attempts to narrow the lumen by an inflammatory response or scar tissue:**
  - Bezold 1908 salicylic acid/boric acid powder (1:4 ratio) insufflation
  - McAuliffe 1989 nitric acid and phenol
  - Chemical cauterization: 20 % silver nitrate
  - Robinson 1989 diathermy
  - DiBartolomeo,1992 Nasal Drop Irritant (diluted hydrochloric acid, chlorobutanol and benzyl alcohol) (no FDA approval)
  - Atsushi 2007 Ligation of Eustachian tube by Nylon
  - Rotenberg 2013 Fat grafting and torus tubaris ligation by Vicryl

# Treatment

## ✧ Attempts to narrow the lumen by compression:

- Zollner,1937 Paraffin injection
- Pulec,1967 Teflon orifice of anterolateral wall (discontinued due to cerebral thrombosis and deaths)
- Ogawa,1976 gelatin sponge injection (Gelfoam injection)
- Doherty,2003 Autologous fat or cartilage graft plugging of the eustachian tube + myringotomy and VTI
- Dennis S. Poe, 2007 Autologous cartilage or Alloderm implant (PETR)

# Gelatin sponge injection

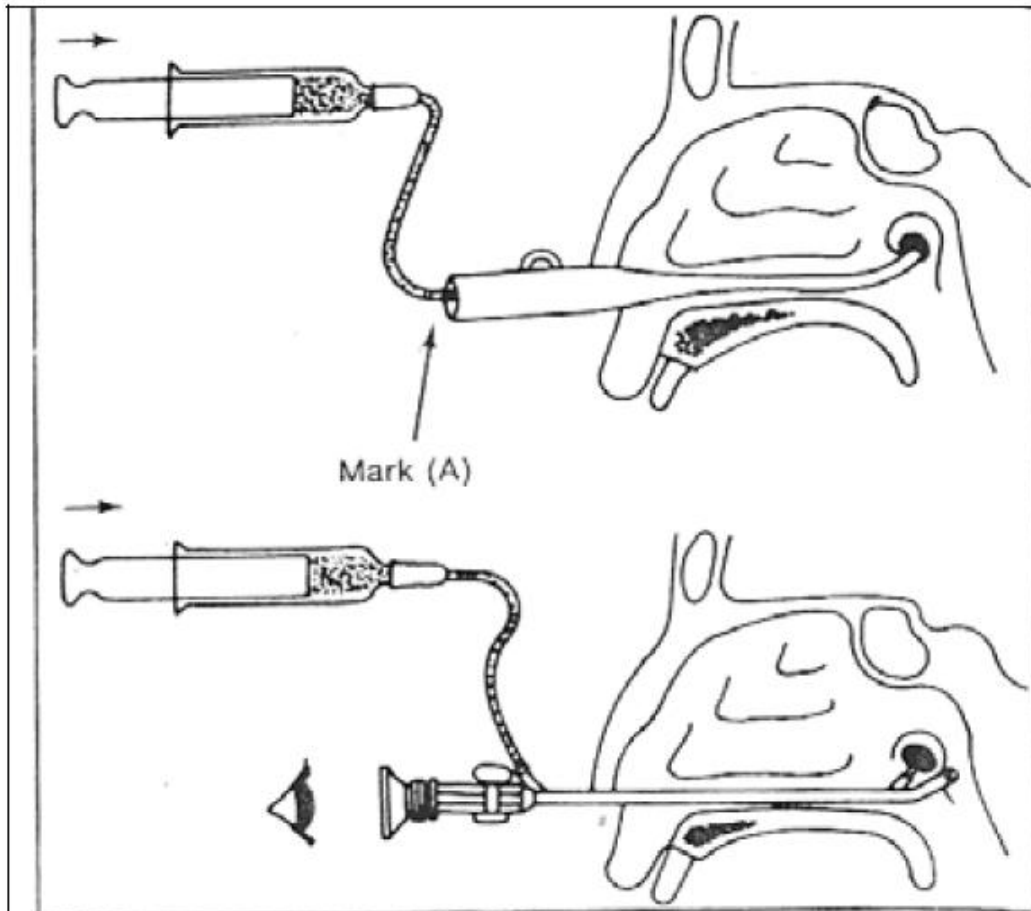
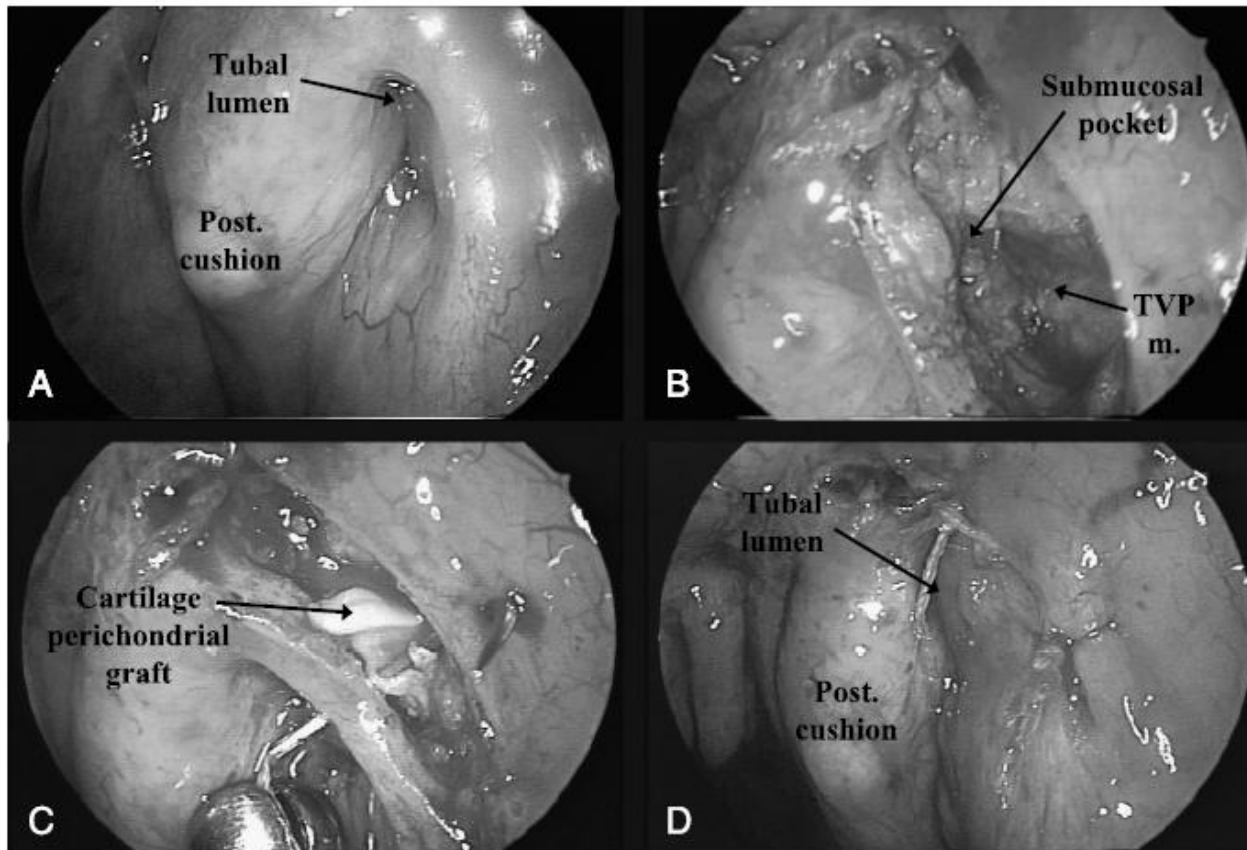


Fig 2.—Infusion of absorbable gelatin sponge solution into Eustachian tube. Upper part of figure shows infusion by means of Eustachian tube catheter. Lower part of figure shows nasopharyngoscope method.

Ogawa S; Satoh I; Tanaka H:Patulous Eustachian tube. A new treatment with infusion of absorbable gelatin sponge solution. Arch Otolaryngol 1976;102 :276-280.

# Patulous E Tube Reconstruction (PETR)



# Treatment

## ✧ Myringotomy and insertion of a ventilating tube

➤ Suehs, 1960, 50% Temporary relief

✓ most effective in relieving the sensation of the tympanic membrane moving during breathing.

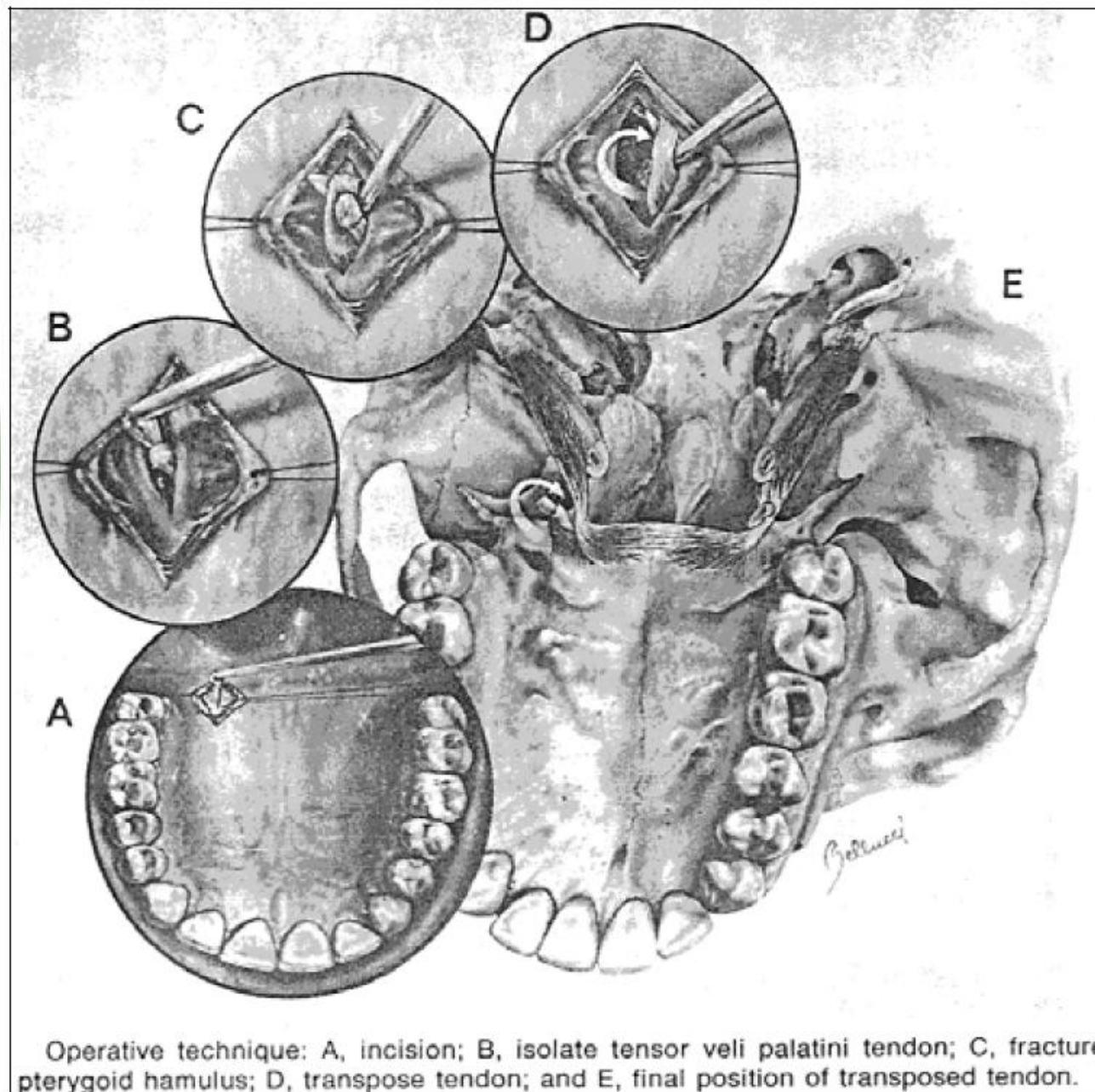
## ✧ Attempts to alter function of the palatal muscles

➤ Stroud 1974 transposition of tensor veli palatini tendon medial to pterygoid hamulus (transpalatal approach).

➤ Transection of tensor veli palatini

➤ Virtanen, 1982 Pterygoid hamulotomy





Virtanen H; Palva T: Surgical treatment of patulous eustachian tube. Arch Otolaryngol 1982, 108 :735-739.

# Take home message

## Anatomy

- ✦ Tensor veli palatini
- ✦ Ostmann's fat pad and pterygoid plexus.
- ✦ The tubal valve (defect in anterolateral wall)

## Diagnosis

- ✦ History and otoscopic findings

## Treatment

- ✦ Reassurance and medical treatment
- ✦ Surgery in intractable cases.

# Reference

- 🍃 **UpToDate search**
- 🍃 **Update on eustachian tube dysfunction and the patulous eustachian tube.** Curr Opin Otolaryngol Head Neck Surg 13:277-282, 2005
- 🍃 **Diagnosis and Management of the Patulous Eustachian Tube.** Otology & Neurotology 28:668-677, 2007
- 🍃 **Endoscopic ligation of the patulous eustachian tube as treatment for autophony.** Laryngoscope, 123:239–243, 2013