

The pharyngeal recess/Eustachian tube complex forms an acoustic passageway

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ABSTRACT

We propose that the complex formed by the Pharyngeal Recess and Eustachian Tube, acts as an acoustic passageway for sounds originating inside the body: sounds made by one's voice, breathing, mastication, one's heartbeats. The antagonistic effect of two sets of muscles, one innervated by the trigeminal nerve, the other by the vagal nerve and cervical plexus, enables the body to modulate transmission of sound via this passageway and hence modulate the awareness of body sounds. Impairment of this system can be due to local factors, such as adhesions over the pharyngeal recess or inflammation inside the pharyngeal recess and/or Eustachian tube; or to tensions of the muscles involved, related to other causes. Dysfunction of the system can lead to symptoms related to increased or decreased awareness of body sounds, such as autophony, hearing of pulsating sounds and clicks in the ear; sensory symptoms related to increased activation of the nerves such as fullness feeling in the ear, facial pain, burning mouth syndrome, globus pharyngeus, pharyngeal pain; and symptoms related to inappropriate muscular contraction such as masticatory and cervical muscle tensions, bruxism, and tension type headache. The functioning of this acoustic passageway is related to the concept of the Trigemincervical complex. The concept of Vagocervical complex is proposed.

Introduction

The posterolateral wall of the nasopharynx contains two invaginations: the pharyngeal ostium of the Eustachian Tube (ET) and the pharyngeal recess (PR) (Fig. 1).

ET: anatomy, physiology and concept of pressure related function

Located laterally is the pharyngeal ostium of the ET, giving access to the cartilaginous part of the ET (Fig. 2).

The ET is bordered by a cartilaginous structure with a medial and lateral lamina. The lumen of ET consists of two portions [1]; the lower one is narrowed by the presence of lateral Ostmann's fat pad (OFL). Cranial to the ET, is medial Ostmann's Fat pad (OFM). The ET is suspended by a lateral and medial suspensory ligament, with OFM in between. The lateral suspensory ligament passes into the tendon of the lateral layer of the tensor veli palatini muscle [1] (TVP). Several muscles are associated with ET: TVP [1,2] (embryologically and functionally related to the tensor tympani muscle (TT) in the middle ear) and medial pterygoid muscle [3] (MPM) are innervated by the mandibular branch of the trigeminal nerve, the levator palatini muscle (LVP) and salpingopharyngeal muscle (SPM) by the pharyngeal branch of the vagal nerve.

ET function has been studied extensively. At the end of the 19th

century, a “pressure regulating function” was suggested for this structure: protection and ventilation of the middle ear, and clearance of middle ear substances such as mucus [4]. The function of the associated muscular apparatus then, has always been examined and interpreted with this ET pressure regulation function in mind (Fig. 3).

As concerns the trigeminally innervated muscles: the TVP is seen as the principal ET opening muscle. It opens up the cranial part of the ET in a slit-like fashion, and this mostly in the posterior two thirds of the ET [5]. At the same time, it compresses the lumen and OFL located in the caudal part [6]. It rotates the medial cartilage in a medio-superior direction. Laterally, MPM contraction pushes, by its volume effect, the lateral wall of the ET medially [7], thereby decreasing ET opening, closing ET. As for the vagally innervated muscles: LVP is generally assumed to play only a secondary role in ET opening. It pushes the anterior part of the medial cartilage medially, thereby opening the lower part of ET in its anterior third part [8]. The role of the SPM remains unclear.

A very complicated system indeed! One wonders why evolutionary forces have not produced a much simpler and economical system. In other organs, such as the esophagus, stomach, bladder, and gall bladder the same functions are very well taken care of by a simple sphincter combined with a ciliary epithelium. Strangely also, the innervation does not support a clear antagonistic function: stimulation of the mandibular branch of the Trigeminal nerve will open ET through TVP

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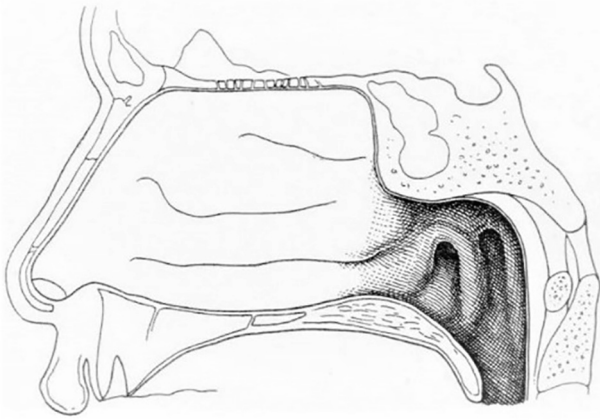


Fig. 1. The posterolateral wall of the nasopharynx with anterior/lateral the pharyngeal ostium of the Eustachian tube, and posterior/medial the Pharyngeal recess. In between, and separating these invaginations, is the Torus Tubarius (cartilage) (from: Terracol J, Corone A, Guerrier Y. La Trompe d'Eustache. ets Masson et Cie, 1949. p. 26).

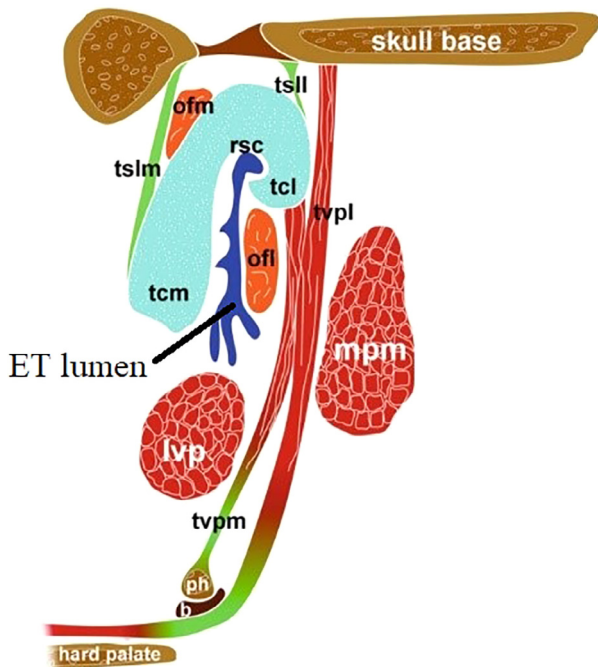


Fig. 2. ET lumen in dark blue. OFM (medial Ostmann's fat pad), OFL (lateral Ostmann's fat pad), tubal cartilage with medial (TCM) and lateral lamina (TCL). Medial and lateral tubal suspensory ligaments (TSLM and TSLL). Some of the muscles: levator veli palatini muscle (LVP), tensor veli palatini muscle with a medial and lateral layer (TVPM and TVPL), lateral pterygoid muscle (MPM). From: Dornhoffer JL. A Practical Guide to the Eustachian Tube. With permission. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

contraction and at the same time close it through MPM contraction. Moreover, the function of SPM, OFM and OFL, and the complex anatomy of the ET itself with its lateral and medial lamina, remains unexplained.

PR: anatomy, and possible function

The more medial invagination, in the postero-superior wall of the nasopharynx, is the PR. It extends in a supero-lateral direction, up to some mm from the skull base. Its dimensions are highly variable. Medially, the PR is bordered by the M. Rectus capitis anterior and M.

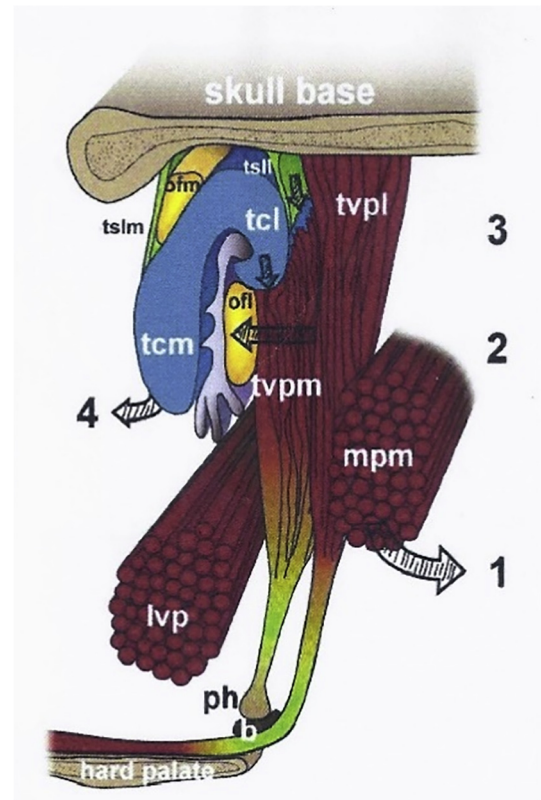


Fig. 3. Main force vectors determined by the muscular coordination of the Eustachian tube: (1) anterolateral rotation of the medial pterygoid muscle during relaxation; (2) pressure forces of the lateral layer of the tensor veli palatini muscle on the Ostmann's fat pad; (3) laterocaudal traction of the medial layer on the lateral lamina of the cartilage, (4) mediocranial rotation of the medial lamina of the cartilage. Tvp m medial layer of tensor veli palatini muscle, tvp l lateral layer of tvp, ph pterygoid hamulus, b bursa, lvp levator veli palatini muscle, mpm medial pterygoid muscle, tcm tubal cartilage, medial lamina, tcl lateral lamina, ofm medial Ostmann's fat pad, ofl lateral Ostmann's fat pad, tslm medial tubal suspensory ligament, tsll lateral tubal suspensory ligament. Salpingopharyngeal muscle is not shown. From: Dornhoffer JL. A Practical Guide to the Eustachian Tube. (Graphical model by Daniela Beyer, MA, Hannover University Medical School). With permission.

Longus capitis. These prevertebral muscles, also called deep cervical flexor muscles, are innervated by the cervical plexus (ventral rami of spinal nerves C1, C2 for the rectus capitis anterior, and C1-C4 for the longus capitis). Between the PR, the skull base and the ET is OFM. The lateral boundary of PR is formed by the medial lamina of the ET cartilage.

To our knowledge, no function has been attributed to the PR. Research is very limited, and most papers focus on its role as a possible location of foreign bodies or tumours. One paper explores a relation between PR inflammation and otitis media with effusion [9]. But older literature – from the time before the pressure regulation idea for ET had taken hold – provides some intriguing findings. Myles [10] in 1897 describes tearing adhesions over the pharyngeal recess with subsequent relief of unspecified ear symptoms. Royet [11] in 1904 describes *throat complaints associated with ear complaints* linked to adhesion formation between the tubal cartilage and the dome of the pharynx. He claims that tearing the adhesions between ET and the posterior pharyngeal wall, and crushing granulation tissue (later called the “Royet-Jacod manoeuvre”), is very efficient in eliminating many of the complaints. More recently, the same manoeuvre has resurfaced under various names as “pharyngioplasty” [12] and “Muncie technique” [13]. Both techniques are claimed to cure *trigeminally related complaints with or without ear complaints*.

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