# Endoscopic Anatomy and Ventilation of the Epitympanum

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**KEYWORDS**

• Endoscopic ear surgery • Epitympanum • Middle ear ventilation • Surgical anatomy
• Prussak space

**KEY POINTS**

- The superior attic (upper unit) is in communication with the mesotympanum through the underlying tympanic isthmus and posteriorly it is open to the aditus ad antrum.
- The inferior lateral attic and the Prussack space are lower than the epitympanic diaphragm, and it is ventilated by the mesotympanum.
- An isthmus blockage associated with a complete tensor fold leads to inadequate ventilation of the mastoid cells and this scenario could be at the basis of the attic retraction pocket development.
- During surgery, in sectorial disventilatory disorders caused by isthmus block, it is essential to restore the ventilation pathway through the isthmus and to create an alternative direct ventilatory route between the protympanum and anterior attic from a section of the central portion of the tensor fold.
- Endoscopic middle ear surgery may help in understanding the physiopathology of the middle ear, allowing the surgeon to explore middle ear anatomy, and thus all ventilation pathways.

## INTRODUCTION

Aeration of the tympanic cavity and mastoid cells and anatomic pathways for middle ear ventilation have been studied since the end of the nineteenth century, starting with the work of Prussak[1] in 1867. More recently, Palva and Johnsson[2] were the first to describe middle ear anatomy focusing on ventilation patterns and their implications for middle ear disease.

The eustachian tube (ET) plays a crucial role in maintaining middle ear aeration and atmospheric pressure. Inflammatory middle ear chronic disease is usually related to

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ET dysfunction caused by poor tympanic ventilation. This condition is also related to hearing impairment and poor postoperative outcomes.[3] Although middle ear aeration is related to ET function, other anatomic factors may play important roles in ventilation of these spaces and, in particular, in the pathophysiology of selective epitympanic retraction.

In recent years, the use of endoscope with varied angulations has allowed the surgeon to explore all of the hidden areas that are often not visualized using a microscope.[4–7] Endoscopes have also improved knowledge of the complex fold anatomy and functional interventions in middle ear inflammatory disorders during middle ear surgery, particularly in the case of selective dysventilation.[8]

This article discusses the anatomy of the epitympanum and the ventilation patterns and pathophysiology of epitympanic retraction.

### *The Epitympanic Compartments (Anterior and Posterior Epitympanum) and the Concept of Upper and Lower Units*

The epitympanum is divided into 2 compartments: a large posterior compartment and a smaller anterior compartment. The demarcation between the anterior and posterior epitympanum depends on the anatomic variations of important structures such as the cog and the tensor fold. In most people, the demarcation between the anterior and posterior epitympanum is represented by the transverse ridge or cog. The cog is a bony septum that detaches from the tegmen tympani cranially, leading vertically toward the cochleariform process in front of the malleus head.

Much of the posterior epitympanic volume is occupied by the body and short process of the incus together with the head of the malleus. The lateral portion of the posterior epitympanum is narrow and is divided by the lateral incudomalleolar fold in 2 further portions, the superior and inferior lateral attic, positioned separately one above the other.

The incudomalleolar fold originates at the posterior extremity of the short process of incus and the lateral portion of the posterior incudal fold, continuing anteriorly between the body of the incus, the head of the malleus and the lateral aspect of the attic. At this level, the fold bends inferiorly, joining the posterior malleolar ligament fold and the lateral malleolar ligament fold, with which it forms the medial and superior aspect of the Prussak space (**Fig. 1**).

The inferior lateral attic is bounded superiorly by the lateral incudo-malleolar fold. This anatomic area is therefore in a lower position than the epitympanic diaphragm in communication with the underlying mesotympanum. Ventilation of the inferior lateral attic is provided by the mesotympanic region. In a more cranial position than the inferior lateral attic lies the superior lateral attic, whose floor or inferior limit is represented by the incudomalleolar fold. Together with the medial attic, this anatomic area is called the superior attic or upper unit.

The superior attic is in communication with the mesotympanum through the underlying tympanic isthmus, and posteriorly it is opened to the aditus ad antrum. Its upper limit is the tegmen tympani, the lower limit is the second (intratympanic) portion of the facial nerve, and laterally it is bounded by the bony lateral wall of the atticus. The superior attic is therefore ventilated through the isthmus (**Fig. 2**).

The lower unit is formed by the reduced space represented by the Prussak space, which is separated in its anatomy and ventilation from the upper unit by its vault, represented by the lateral malleolar ligament fold. This inferior epitympanic portion is ventilated in most cases from the posterior pocket through mesotympanum (see **Fig. 1** panel D).

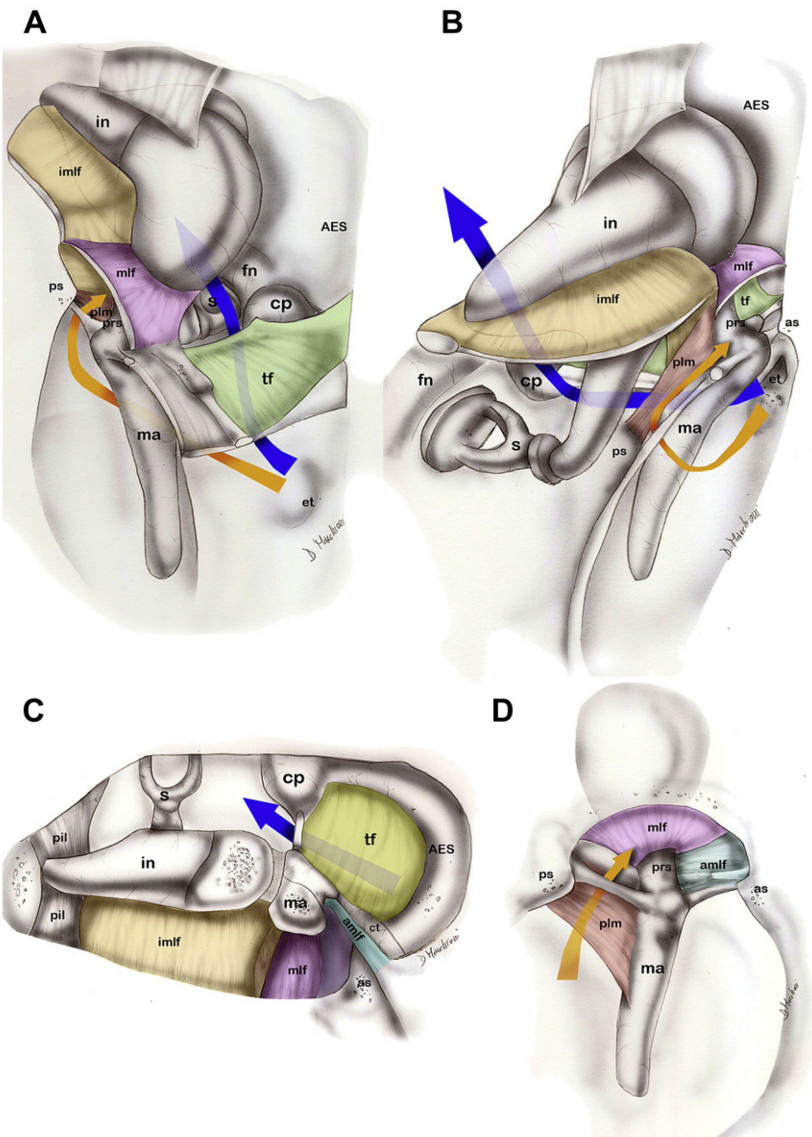


**Fig. 1.** The malleolar ligament folds and membranous folds representing the complete epitympanic diaphragm, and the 2 major middle ear ventilation pathways of the epitympanic compartments (*blue arrow*) and Prussak space (*orange arrow*). (*A*) Anterior view. (*B*) Posterior view. (*C*) Axial view according to Palva. (*D*) Lateral view of Prussak space. AES, anterior epitympanic space; amlf, anterior malleal ligamental fold; as, anterior spine; bin, body of the incus; cp, cochleariform process; ct, corda tympani; et, eustachian tube; fn, facial nerve; hma, head of the malleus; imlf, lateral incudomalleal fold; in, incus; ma, malleus; mlf, lateral malleal ligamental fold; PES, posterior epitympanic space; pil, lateral and medial posterior incudal ligaments; plm, posterior malleal ligamental fold; prs, Prussak space; ps, posterior spine; s, stapes; sr, supratubal recess; tf, tensor fold. The orange arrow indicates the major ventilation pathway through the posterior pocket.

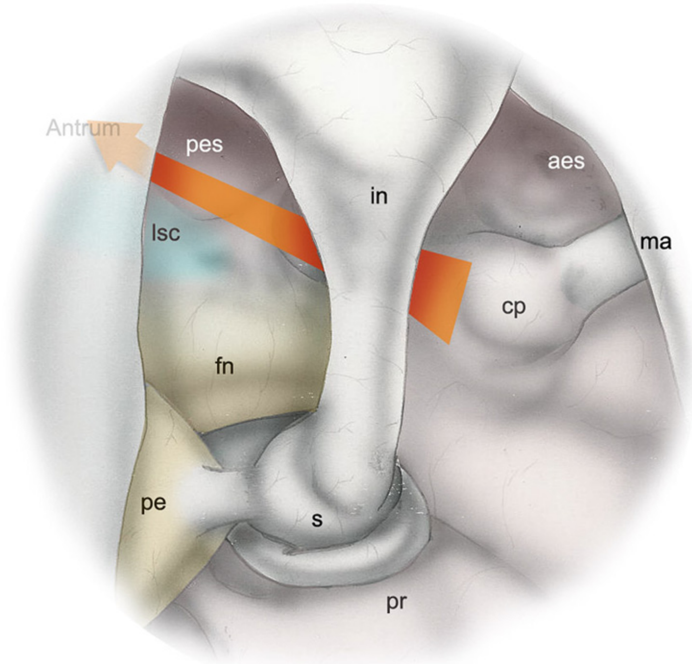


**Fig. 2.** Right ear. The posterior isthmus after posterior atticotomy maintaining the integrity of the ossicular chain (the red arrow represents the main ventilation route from the ET to the antrum through the isthmus). aes, anterior epitympanic compartment; cp, cochleariform process; fn, facial nerve; in, incus; lsc, lateral semicircular canal; ma, malleus; pe, pyramidal eminence; pes, posterior epitympanic compartment; s, stapes; tf, tensor fold; ttc, tensor tympani canal.

The 2 ventilatory trajectories of the epitympanic units are therefore separated from each other; this pathophysiologic concept is important in transcanalar endoscopic surgery, because surgical treatment is based on the restoration of ventilation and on the unification of the upper unit with the lower unit, through the creation of a large tympanic isthmus and an accessory route through the tensor fold. The surgical solution must ensure the ventilation of all parts of the epitympanum.

The anterior epitympanum is delimited anteriorly by the root of the zygomatic arch (a thick bony plate that separates it from pericarotic cells), superiorly by the tegmen tympani (which separates it from the meninges), laterally by the tympanic bone and chorda tympani, and medially by a bony wall that separates it from the geniculate fossa, which contains the homonymous ganglion. Its inferior limit is represented by the tensor fold, which, if complete, separates it from the underlying sovratubaric recess. The tensor fold presents a variable anatomy: according to Palva and colleagues,[9] the tensor fold is incomplete in only 25% of cases, allowing an alternative ventilation route directed from the sovratubaric recess toward the attic (**Fig. 7**). It extends laterally from the semicanal of the tensor tympani muscle to the lateral aspect of the protympanum, posteriorly adhering to the cochleariform process and to the tensor tympani tendon, and extends anteriorly to the root of the zygomatic bone to provide the epitympanic floor.

If it inserts on the transverse crest, its direction is almost vertical, whereas, if inserts on the tubaric tegmen, its direction is horizontal.

In most cases the curvature is about 45° and its most frequent insertion lies at the central portion of the anterior sovratubaric-epitympanic tegmen. According to our observations on patients affected by attic cholesteatomas, a complete tensor fold has been observed in almost all the patients studied, and the direction of the fold was in most cases horizontal.[4] In general, the width of the underlying sovratubaric recess varies depending on its angle (**Fig. 3**).

During surgery, in sectorial ventilatory disorders caused by isthmus block, it is essential to create an alternative direct ventilatory route between the protympanum and anterior attic from a section of the central portion of the tensor fold.

The anterior epitympanum can be formed from a single large air cell, or by several small air cells, and this makes the anterior epitympanum a variable anatomic space in an anterior-posterior direction. In a recent study conducted at our clinic, subjects affected by cholesteatoma limited to the attic showed a reduced volume of the bony boundaries of the anterior epitympanum. The small anterior epitympanic cavities might be proof of selective attic dysventilation.

### *Epitympanic Diaphragm and Epitympanic Ventilation Patterns*

The concept of epitympanic diaphragm was raised for the first time by Lemoine in 1950;[5] the investigators described that the diaphragm was made up of various structures and membranous ligaments that, together with the malleus and the incus, form the floor of the epitympanic compartment.

The investigators also described the Prussak area as a structure located inferiorly to this diaphragm, therefore dividing it from the epitympanic compartments by the lateral malleolar ligament fold, considered the Prussak space roof.

In addition to the folds described by Lemoine, Palva[2] added 2 more duplicated folds: the tensor fold and the lateral incudomalleolar fold. The complete diaphragm therefore comprises the 3 malleolar ligament folds (anterior, lateral, and posterior),

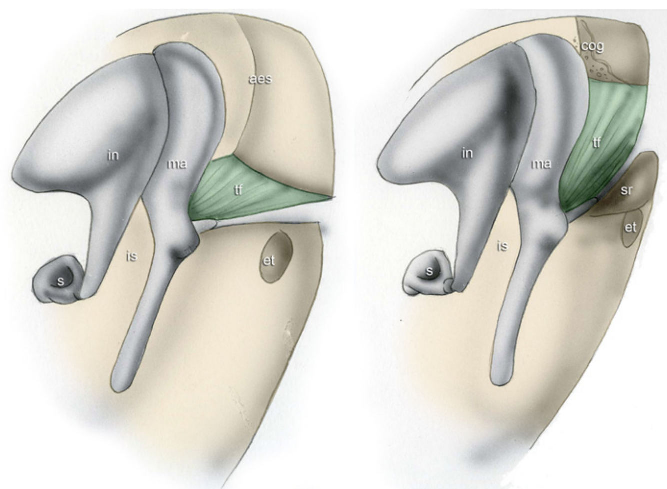


**Fig. 3.** Right ear. The variations in size of the supratubal recess. The dimensions of this recess depend on the inclination of the tensor fold (*right*). The more vertical the tensor fold, the wider the supratubal recess. When the tensor fold is a horizontal, the supratubal recess is not present (*left*). et, eustachian tube; in, incus; is, isthmus; ma, malleus; s, stapes; sr, supratubal recess; tf, tensor fold.

the posterior incudal fold, and the 2 duplicated membranous folds (tensor fold and the lateral incudomalleolar fold) associated with the incus and the malleus.

Palva classified Proctor's anterior tympanic isthmus as a single entity that is always present, and defined it simply as the tympanic isthmus, whereas the ventilation route posterior to the incus, an irregular feature named by Proctor[6] the posterior isthmus, provides inconsistent ventilation from the fossa incudis.

The tympanic isthmus described by Palva represents a wide ventilation route for the epitympanum, excluding the Prussak space.

This structure extends anteriorly from the tensor fold to the pyramidal process (inferiorly and posteriorly) and to the medial portion of the posterior incus ligament (superiorly and posteriorly). Its medial limit is the attic bony wall and the lateral limit is the body of the incus, the incus short process, and the head of the malleus.

The space bounded by these structures is called the middle attic, which becomes the mesotympanum inferior to the body incus.

The anterior portion of the tympanic isthmus, superior to the level of the tensor tympani tendon, represents a wide communication with the anterior epitympanum. In healthy ears, the tympanic isthmus is an open structure with no fold.

Although Palva noticed a wide opening just behind the incus short process in 25% of Proctor posterior tympanic isthmus, in most cases this potential posterior ventilation route was blocked by the posterior incus ligament fold.

Given this, all the compartments leading to the epitympanic diaphragm receive air through the only ventilation way that is always present, the tympanic isthmus route, located between the medial aspect of the posterior incus ligament and the tensor fold.

However, Palva[2,9] noticed that membranous folds that formed the epitympanic diaphragm could have structural defects resulting in incomplete folds.

In this way, additional ventilation patterns arise for the structures above the epitympanic diaphragm. Most of the defects were of the tensor fold (29% of cases), followed by the lateral incudomalleolar fold in its anterior portion (15% of cases).

## *The Prussak Space*

The medial and inferior aspects of the Prussak space are formed respectively by the neck and the short process of the malleus.

The superior limit is the fold of the lateral malleolar ligament, which also represents the floor of the lateral malleolar space; this ligament inserts laterally on the medial wall of the scutum. The lateral malleolar ligament fold is integral in most case, because according to Palva[9] only 19% of subjects showed a defect in the anterior portion of the fold, whereas, in some rare cases (7% of the subjects examined by Palva), the defect was in the posterior portion of the ligament, the latter involving the lateral malleolar ligament fold, creating a communication between the upper epitympanic portion (upper unit) and the lower (lower unit), resulting in a communication between the Prussak space and the lateral malleolar space and creating a change in the classic epitympanic diaphragm.

The anterior aspect of the Prussak area is bounded by a thin, membranous fold among the tympanic membrane and the anterior malleolar ligament fold, which inserts laterally on the tympanic membrane and medially on the neck and long process of the malleus.

In some cases, this fold is absent, causing a further anterior ventilation trajectory to the Prussak space.

The lateral aspect is represented by the Sharpnell membrane.

The posterior wall is represented by a large posterior pocket (the posterior pocket of von Tröltsch), which is the main route of ventilation. This posterior pocket is bounded laterally by the pars tensa and pars flaccida of the tympanic membrane, and medially by the posterior malleolar ligament fold, which originates from the posterior portion of the malleus neck and the upper third of the malleus handle and inserts posteriorly in the posterior tympanic spine (**Fig. 1**; Panel D). This posterior pocket develops in a posterior-inferior direction and opens at the most cranial portion of mesotympanum, so, in most people, ventilation of the Prussak space occurs through the communication with the mesotympanum, the only ventilation route that is separated from the epitympanic upper unit. This ventilation route of the inferior epitympanic compartment through the posterior pocket of von Tröltsch is rough and narrow, especially compared with the ventilation route through tympanic isthmus, which aerates the upper epitympanic compartment and is wider. For these reasons, the possibility of anatomic reduction of the passage until the closing of the posterior pocket is plausible, especially the presence of thick and viscous secretions within the Prussak space that could cause a chronic sectorial dysventilation associated with a retraction of the Sharpnell membrane and its adhesion with the malleus neck.

For these reasons, although the Prussak space is anatomically inseparable from the epitympanum, in terms of ventilation and drainage, it represents an independent unit.

This space may have a block and/or an obliteration without any involvement of the compartments above the epitympanic diaphragm, like the anterior and posterior epitympanum, the aditus, and mastoid cells.

Palva dissected subjects on ventilation tubes for epitympanic retraction, showed that, despite the surgical treatment, an attical dysventilation was still present.[2]

Given these phenomena, Palva assumed that behind the genesis of attical cholesteatoma there was a progressive closure of the ventilation route of the inferior epitympanic unit (lower unit) initially derived from mucous tissue inflammation in the posterior pocket and Prussack space, then from the granulation tissue formation that progressively causes a total block to the passage of air from this route. These events could lead to retraction of the Sharpnell membrane toward the malleus neck. The positioning of a ventilation tube causes an improvement in mesotympanic and hypotympanic ventilation, but does not address the blockage in the posterior pocket, and the process of retraction would be irreversible. It is still debated whether these phenomena are sufficient to cause an attical cholesteatoma.[10]

## DISCUSSION OF MIDDLE EAR ANATOMY

Intraoperative evaluation of middle ear anatomy during endoscopic surgery for inflammatory disorders allows the visualization of anatomic blockages of the middle ear ventilation patterns.

Many other investigators have described the anatomy and development of tympanic compartments and folds because this knowledge is crucial in the understanding and treatment of middle ear disease.

More recently, tympanic isthmus and middle ear ventilation patterns have been described in several articles.

Palva and Johnsson[2,9] studied the anatomy of the tensor fold during temporal bone dissection. They observed that, in most patients, the tensor fold was a complete fold separating the epitympanic compartment from the protympanum. In these patients, the isthmus was the only aeration pathway; however, in rare cases, it is possible to observe an incomplete tensor fold; in these cases, the anterior epitympanic space received aeration directly from the protympanum through the communication in the tensor fold area.

Although exploration of the tensor fold region during middle ear surgery for chronic disease has already been established in the international literature, it is not easy to reach this region in otomicroscopy.

Several approaches have been described in the international literature, but we suggest an endoscopic approach to the tensor fold in patients with attic disease, which could be exclusive or combined with the traditional microscopic approach.[11]

In our previous study[12] focused on epitympanic size in patients affected by a limited attic cholesteatoma, we observed that the anterior epitympanic recess (AER) in an affected ear is smaller than in an unaffected ear. We hypothesized that the presence of a tympanic isthmus blockage associated with a complete tensor fold could exclude the AER from the posterior epitympanic space and from the protympanum. The blockage of the tympanic isthmus could create a selective negative pressure in the atticomastoid spaces; this chronic lack of aeration could provoke a hypodevelopment of the AER with a reduction of pressure level and, consequently, an attic retraction and cholesteatoma sac development (**Fig. 4**). This process is also possible in patients with a normally functioning ET.

## *Middle Ear Blockage*

An isthmus blockage caused by chronic inflammatory disease in association with a complete tensor fold leads to inadequate ventilation of the mastoid cells and epitympanic recess. Middle ear pressure seems related not only to a functioning ET but also to transmucosal gas exchange through the mastoid mucosa. The mucosal gas exchange is related to the degree of mastoid pneumatization.[13] Because of these 2 gas pressure regulation systems, even if the ET is functioning, an isthmus blockage could impair ventilation of the mastoid cells, causing sclerotization of the mastoid. It is not clear whether chronic middle ear disease leads to inadequate mastoid pneumatization or, conversely, a sclerotic mastoid leads to chronic middle ear disease.[14]

In a recent study,[4] we described the kinds of anatomic blockage of the middle ear ventilation trajectories that may be identified during endoscopic surgery to understand whether those alterations could be associated with anomalous mastoid pneumatization, a classic sign of middle ear dysventilation problems.

In this study, the anatomic structure that separates epitympanic space from the mesotympanum (tympanic isthmus and tensor fold area) was studied. No previous studies have been performed on the surgical approach for patients affected by a middle ear chronic disease with blockage of the isthmus. Intraoperative evaluation of middle ear anatomy during endoscopic surgery allowed us to clearly visualize the presence of anatomic blockage of the middle ear ventilation trajectories. We classified these anatomic blockage patterns into 3 types (**Fig. 5**):

- Type A: blockage of the isthmus associated with a complete tensor fold (most of these patients presented a selective attic retraction pocket or attic cholesteatoma without pathologic tissue in the mesotympanic spaces)
- Type B: blockage of the isthmus associated with an attical vertical blockage (consisting of a fold or granulation tissue involving the incudomalleal fold) separating the anterior epitympanic space from the posterior epitympanic space with or without a complete tensor fold, in these subjects a selective retraction pocket into the posterior attic was found
- Type C: a complete epidermization of the attic space causing a blockage of the isthmus and a complete antral blockage excluding the mesotympanic space from the epitympanic and mastoid spaces

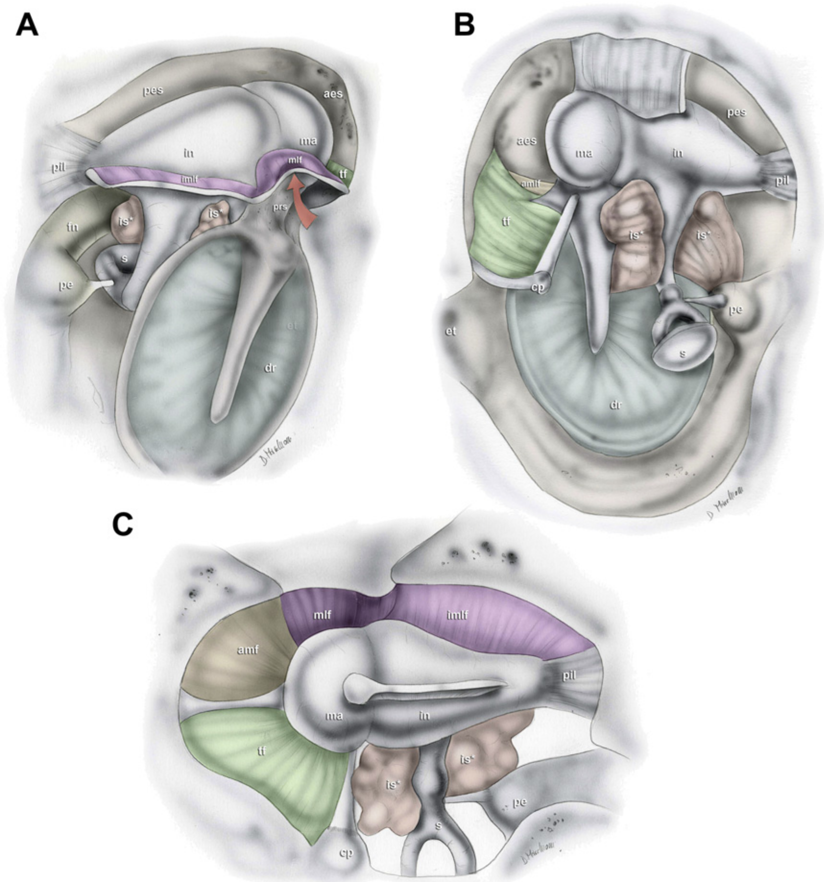


**Fig. 4.** Right ear. Tympanic isthmus block associated with a complete tensor fold. The blockage of the attic aeration pathway could create a selective negative pressure in the atticomastoid spaces, developing a selective retraction in the attic. Transcanal view (*A*); medial to lateral view (*B*); axial view at the level of the attic (*C*). aes, anterior epitympanic compartment; amf, anterior malleal fold; cp, cochleariform process; dr, eardrum; et, eustachian tube; fn, facial nerve; imlf, lateral incudomalleal fold; in, incus; is*, isthmus blockage; ma, malleus; mlf, lateral malleal fold; pe, pyramidal eminence; pes, posterior epitympanic compartment; pil, posterior incudal ligaments; prs, Prussak space; s, stapes; tf, tensor fold.

In our series, tensor fold removal in association with a restoration of the isthmus function prevented postoperative retraction or cholesteatoma recurrence 1 year after the primary surgery. The use of the endoscope during surgery also permitted a good view of the tensor fold area and the isthmus timpani and, consequently, enabled us to understand the type of dysventilation pattern. The goal of surgery in this kind of disorder could be restoration of normal ventilation of the attical-mastoid area. This solution is possible by removing the tensor fold and restoring the functionality of the isthmus.

We recently published another study of middle ear anatomy, focusing on middle ear folds in patients with attical retractions or cholesteatoma and with a normal tubal function test, who underwent endoscopic surgery. This scenario might describe a selective

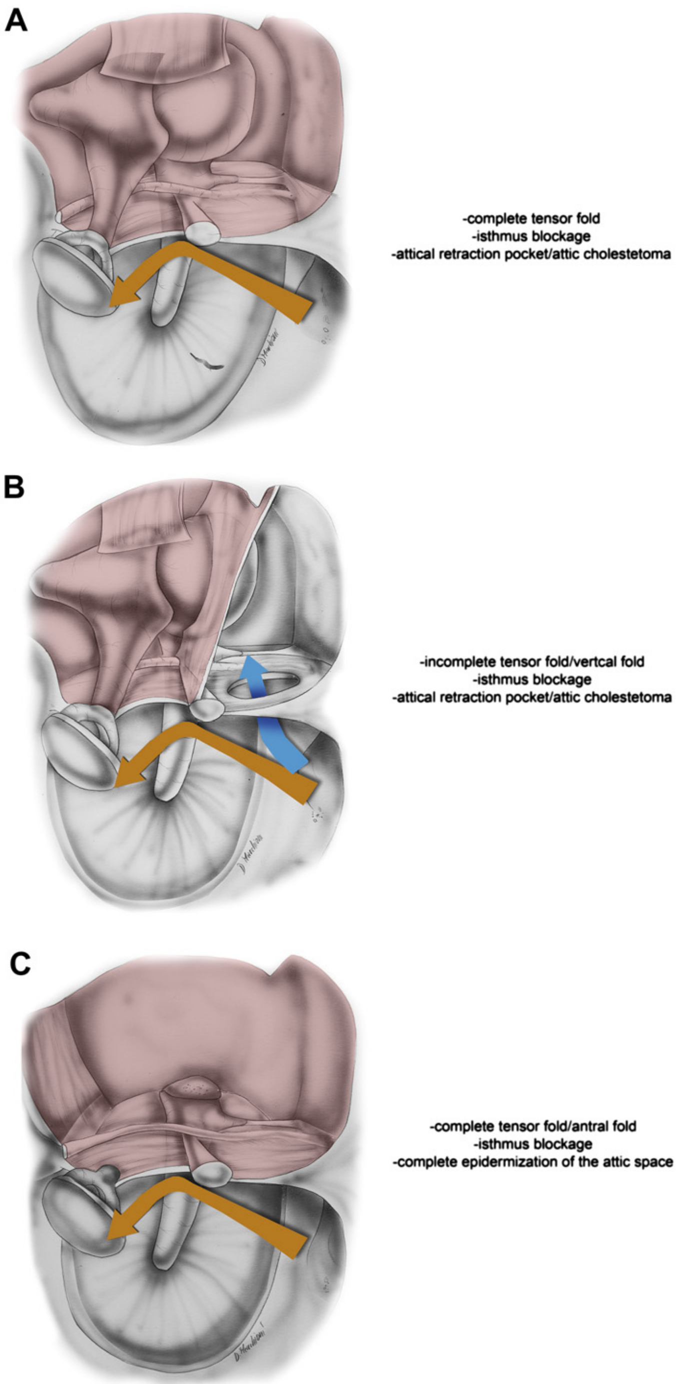


**Fig. 5.** Classification of epitympanic ventilation blockage correlated on the endoscopic findings. Left ear view, from medial to lateral.

epitympanic dysventilation syndrome, possibly not related to ET impairment.[8] Based on the emerging data obtained from our publications, we hypothesize a selective epitympanic dysventilation syndrome (**Fig. 6**).[10] If an isthmus blockage occurs in an ear with complete tensor and incudomalleal folds, a selective epitympanic dysventilation may manifest even with a functioning ET. The syndrome would therefore occur with the contemporaneous presence of 4 conditions: an attic retraction pocket or attic cholesteatoma, a type A tympanogram or a normal tubal function test, complete epitympanic diaphragm, and isthmus blockage.

In clinical practice, it is common to find an isolated retraction pocket of the pars flaccida and/or a attic cholesteatoma, limited to the epitympanum, with an otherwise normal pars tensa and mesotympanum. As confirmed during surgery, an open ET and a good protympanic mucosa appearance were found in cases of selective dysventilation.

To treat this condition, and perhaps to prevent cholesteatoma formation, a surgery of the isthmus should be done restoring the ventilation pathway through this anatomical structure and a new ventilation route should be created during surgery, and this can be performed by endoscopic middle ear surgery in a preservative way.

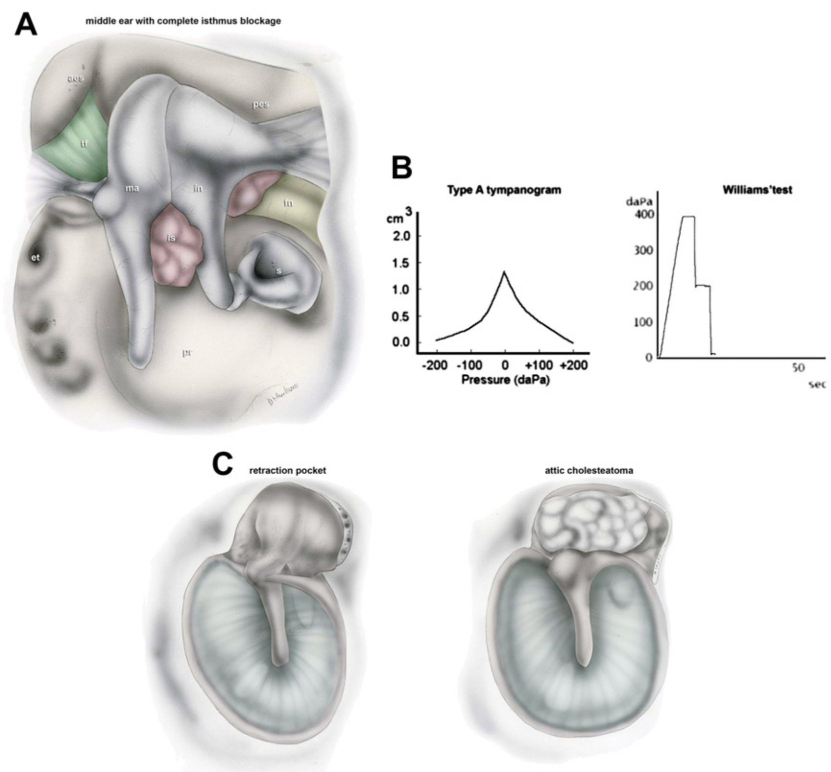


**Fig. 6.** Left ear. Selective dysventilation syndrome. To define this syndrome, 3 conditions are necessary: attic retraction pocket or cholesteatoma (*C*); type A tympanogram or a William test positive for a normal function of eustachian tube (*B*); complete epitympanic diaphragm associated with block of the isthmus (*A*). aes, anterior epitympanic compartment; et, eustachian tube; fn, facial nerve; in, incus; is, isthmus blockage; ma, malleus; pes, posterior epitympanic compartment; s, stapes; tf, tensor fold.

From this point of view, we suggest that, during middle ear surgery, special attention is paid to restoring an isthmus ventilation pathway, removing inflammatory tissue, or creating a new isthmus with an ossiculoplasty; the tensor fold usually should be removed to create an accessory ventilation route to the epitympanum. The aforementioned procedures are necessary for good epitympanic ventilation. Awareness and early diagnosis of selective middle ear dysventilation problems in the future could prevent the development of chronic otitis and cholesteatoma.

In another recent study,[15] we described 3 main types of endoscopic tympanoplasty that can be performed for surgical treatment of attic retraction pockets, preserving the ventilation routes, physiology, and anatomy of the middle ear as much as possible. When the disease is located in the tympanic cavity without mastoid involvement, the exclusive transcanal endoscopic approach was indicated to eradicate the disease, preserving the mastoid function and restoring the ventilation routes of the middle ear.

When an isthmus blockage was present with a normal ossicular chain, the disease was carefully removed from the isthmus by dissecting the pathologic tissue from the incudostapedial joint and the cochleariform process, and restoring ventilation through the isthmus without disrupting the chain. When the tensor fold was complete, the fold was removed, creating a direct communication from the protympanum to the anterior epitympanic space; this surgical procedure was classified as tympanolpasty type 1.

When the retraction pocket is in the superior portions of the epitympanic compartment and it is not completely visible with the endoscope, removal of part of the scutum

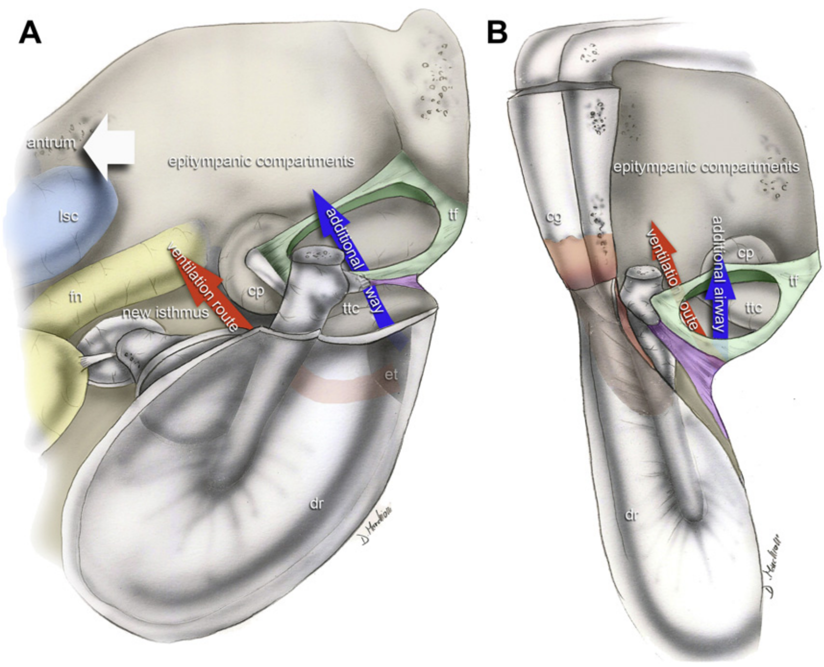


**Fig. 7.** Right ear. Endoscopic tympanoplasty type 2: a ossiculoplasty was performed creating a new functional isthmus (*red arrow* the main ventilation route from the ET to the attic) and the tensor fold was removed creating an additional aeration pathway from the ET to the Attic (*blue arrow*) , Panel A: from later to medial view; Panel B: anterior view. cg, cartilage graft; cp, cochleariform process; dr, eardrum; fn, facial nerve; lsc, lateral semicircular canal; tf, tensor fold; ttc, tensor tendon canal.

is necessary and a wide atticotomy should be performed. A tragal graft has been used to reconstruct small defects, whereas a segment of mastoid cortical bone has been used to reconstruct larger scutum defects.

In patients with an attical aeration pattern with erosion of the ossicular chain or in subjects in whom erosion of the incus is present with disruption of the incudostapedial joint associated with blockage of the isthmus an Endoscopic tympanoplasty type 2 is attempted, new isthmus was created with a lower ossiculoplasty and the head of the malleus was cut, creating a wide and well-ventilated epitympanic compartment. When an isthmus blockage was present with erosion of the long process of the incus, a lower ossiculoplasty was performed with a remodeled incus placed on the stapes. In this way, it was possible to create a new wide isthmus, the tensor fold was removed, creating a direct communication between the protympanum and the anterior epitympanic space and permitting an additional aeration pathway (**Fig. 7**).

In some cases, a complete epidermization of the attical and the antrum region was present, and it was not possible to restore good ventilation in the epitympanic compartments because of the high risk of residual cholesteatoma. What might be termed an endoscopic open technique was performed (Tympanoplasty type 3), excluding the epitympanic compartment from the tympanic cavity by temporalis fascia interposition; the tympanic cavity was excluded from the epitympanum by a complete lateral attic bony wall removal and with interposition of the temporalis fascia in the antrum. This approach allowed us to create ventilation of the middle ear, excluding the mastoid and the epitympanum from the tympanic cavity. In this way, tympanoplasty tensor fold resection was not required because fascia was placed over the tensor fold.

## SUMMARY

The physiopathology of middle ear disease requires proper understanding, and endoscopic middle ear surgery may help provide this, allowing the surgeon to explore all ventilation pathways without radically changing middle ear anatomy. In this way, the surgical approach must be the focused. The restoration of an adequate ventilation route between the mesotympanum and epitympanum, and, in our experience, surgical treatment of attic retraction or cholesteatoma limited to the tympanic cavity, can be achieved exclusively by the endoscopic approach.

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