

Endoscopic Anatomy of the Retrotympanum

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KEYWORDS

• Surgical anatomy • Cholesteatoma • Middle ear • Retrotympanum • Atraumatic

KEY POINTS

- The retrotympanum is located at the posterior portion and houses several important and complex anatomic and surgical structures.
- The greater the depth of the subpyramidal space (SS), the more is a surgical approach at high risk of leaving residual cholesteatoma.
- Use of the endoscope in the middle ear recesses in cholesteatoma surgery may reduce the residual cholesteatoma rate. Using a transcanal minimally invasive approach allows the preservation of bone and mucosa of the mastoid cell system. This atraumatic approach is a suitable method for exploring the mesotympanic structures.
- In type C sinus tympani (ST), especially associated with a well-developed mastoid cell system, it is not always possible to have a good control of the ST using endoscopes; in these cases, a combined (endoscopic-microscopic) posterior retrofacial approach is suggested.

ANATOMY OF RETROTYMPANUM

The middle ear can be divided into subspaces, based on their relationship with the mesotympanum. Superior to it lies the epitympanum; anterior to it, the protympanum; and inferior to it, the hypotympanum.¹

The retrotympanum is located at the posterior portion and houses several important and complex anatomic and surgical structures. Its anatomy represents a challenge both in understanding and visualization, because conventional transcanal microscopic approaches can neither visualize nor preserve some of those important structures.^{1,2} Recently, endoscopic techniques have allowed the complete visualization of these structures.

This article describes the endoscopic anatomy of the retrotympanum and its relationships to other important anatomic landmarks in the middle ear to understand its importance and relevance during surgical procedures.

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The retrotympanum is divided by the subiculum into superior and inferior retrotympanum. The superior retrotympanum can also be subdivided in 4 spaces: 2 medially and anteriorly and 2 laterally and posteriorly to the third tract of facial nerve.^{1,2}

The ST is one of the most important spaces of the retrotympanum. It is represented by¹⁻⁴

- Posterior outpouching cavity lying between the medial wall of the middle ear medially
- The pyramidal eminence (PE) laterally
- Posterolateral delineation by the second genu and third tract of the facial nerve, lateral semicircular canal (LSC), and vestibule
- Close relationship anteriorly with the superior portion of the promontory

The ST is bordered superiorly by the ponticulus that separates it from the posterior tympanic sinus (PTS), a bone niche of the superior portion of the retrotympanum.

PTS is not always present, depending on the presence of ponticulus and the extension of ST, by the oval window, and inferiorly by the subiculum, that separates it from the inferior retrotympanum and round window. This space could also be divided into 3 different types depending on its posterior extension with respect of the third portion of the facial nerve. Laterally and posteriorly to the second genu and vertical portion of the seventh cranial nerve are localized 2 anatomic bone niches: the facial sinus and the lateral tympanic sinus. These niches are separated by the chordal ridge, departing from the posterior portion of the PE. These anatomic regions are more accessible than ST and PTS because they are located laterally to a tangential plane passing on the seventh cranial nerve course, and their anatomies are more constant.¹⁻⁶

The PE is a triangular bony structure, with its base oriented posteriorly and the tip anteriorly. The PE houses the stapes tendon and has a horizontal orientation, lying anteriorly and laterally to the second genu of the facial nerve.^{3,4}

Under this bone structure, that is located at the middle of retrotympanum, is the SS, which is delimited laterally by the medial aspect of the PE, medially by the medial side of the bony wall of the retrotympanum, and posteriorly by the vertical tract of the seventh cranial nerve.

This space can present different morphologies, mostly in its depth, varying from a total absence, because of total ossification of the medial aspect of the PE with the medial wall of retrotympanum, to a particularly deep SS lying beneath the facial nerve.

The inferior retrotympanum is the posterior space that houses the sinus subtympanicus (SSt), delimited posteriorly by the styloid complex and the third portion of the seventh cranial nerve; anteriorly by the round window with its pillars, tegmen, and the inferior and posterior portions of the promontory; superiorly by the subiculum; and inferiorly by the jugular bulb.¹⁻⁶

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Recent endoscopic anatomy study⁷ clearly describes the following ST shape variations:

- a. *Classical shape*: when the sinus is located between the ponticulus and subiculum, lying medial to the facial nerve and to the pyramidal process (**Fig. 1A**)
- b. *Confluent shape*: when an incomplete ponticulus is present and the ST is confluent to the posterior sinus (see **Fig. 1B**)
- c. *Partitioned shape*: when a ridge of bone extending from the third portion of the facial nerve to the promontory area is present, separating the ST into 2 portions (superior and inferior) (see **Fig. 1C**)

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