

Revisiting the Tympanic Arcade in Skull Base Surgery

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Background

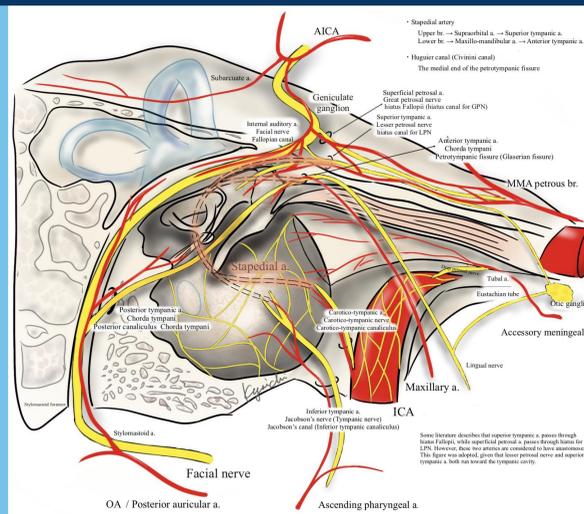
In skull base surgery, a detailed understanding of the anatomy of the external carotid artery system is essential. One component of this system, the **tympanic arcade**, is well known angiographically; however, anatomical knowledge of its surrounding structures remains limited.

Our department chief, Dr. Michihiro Tanaka, always says that

“Anatomy is language. In human embryology, nerves and arteries always develop in close association - running side by side. This fundamental principle provides important clues when navigating complex anatomy.”

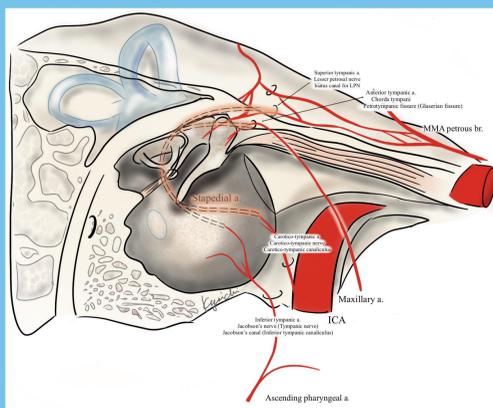
Normally, vessels are visualized on angiography, whereas nerves are examined in cadaveric specimens. In this study, we focused on cadaveric vessels to better understand the three-dimensional anatomy of the tympanic arcade.

The tympanic arcade was conceptually divided into two main components to simplify its complex vascular network: (1) the stapedial artery and its remnants, and (2) the facial arcade, consisting of arteries accompanying the facial nerve.



(1) Stapedial artery and (2) Facial arcade

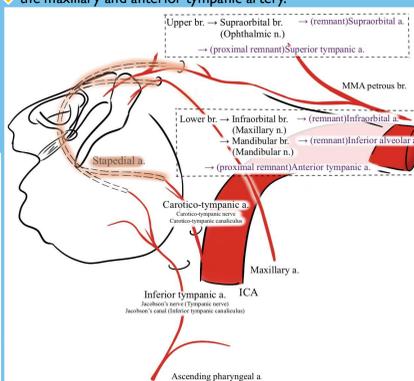
(1) Stapedial artery



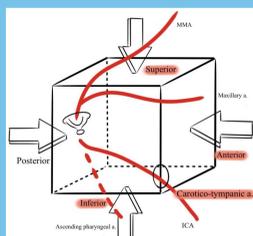
The stapedial artery normally regresses and is absent in adults.

- 1) Superior and 2) Anterior tympanic arteries are distal remnants of the stapedial artery.
- 3) Carotico-tympanic and 4) Inferior tympanic arteries are its proximal remnants.

When the stapedial artery regresses, the upper branch forms the MMA and superior tympanic artery, while the lower branch forms the maxillary and anterior tympanic artery.



1-1. Typical pattern of development

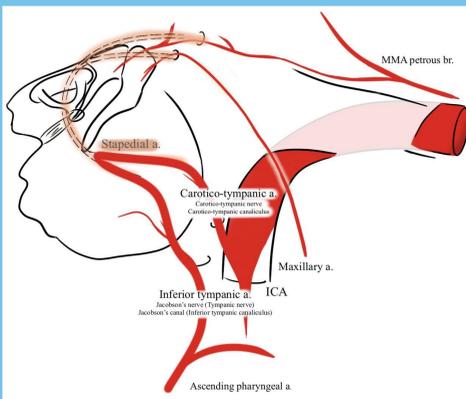
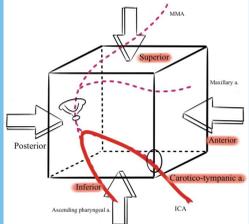


The proximal portion of the stapedial artery remains as the carotico-tympanic artery, and its original distal course is along Jacobson's nerve - similar to the inferior tympanic artery.

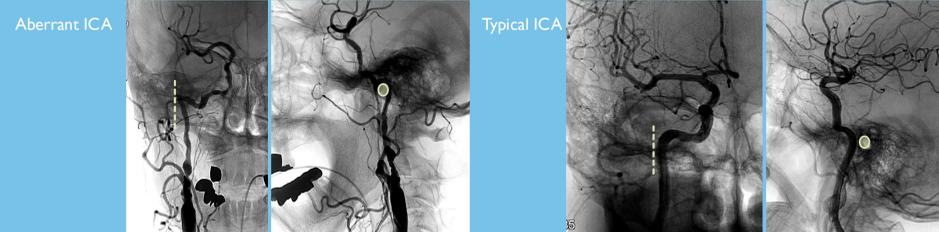
1-2. Aberrant ICA (Intratympanic course of ICA)

When the proximal part of the third aortic arch is absent, collateral flow may develop through the inferior tympanic artery, and this condition is known as an aberrant ICA. In this situation, the blood supply to the brain doesn't come from the usual ICA, but from the ascending pharyngeal artery.

Lasjaunias described this course of the ICA as the intratympanic course of the ICA, emphasizing that only the flow is aberrant.



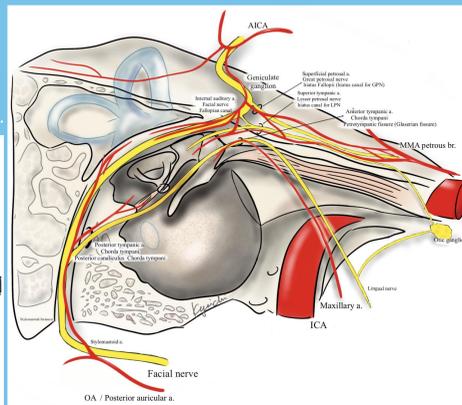
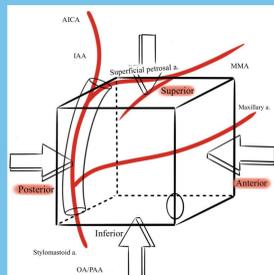
Although it appears normal, this is actually a case of aberrant ICA.



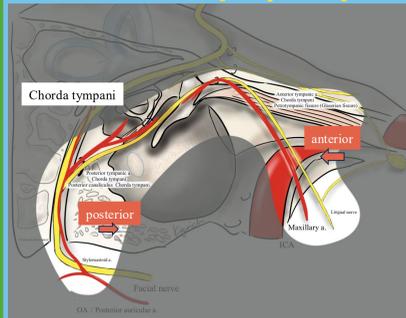
On the AP view, the typical ICA reaches only to the middle of the orbit, while the aberrant ICA extends laterally. On the lateral view, it passes through the tympanic cavity and curves around the external auditory canal.

(2) Facial arcade

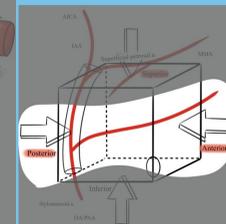
Arteries are typically accompanied by nerves.



2-1. Chorda tympani part



From the most distal part of the fallopian canal, the chorda tympani branches off. It then runs across the tympanic cavity, going from back to front. Posteriorly, it runs with the posterior tympanic artery, and anteriorly with the anterior tympanic artery.



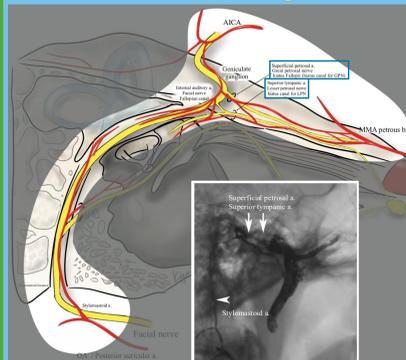
The chorda tympani branches off from the mastoid segment and passes through the posterior canaliculus, running alongside the posterior tympanic artery.

Lt. combined petrosectomy

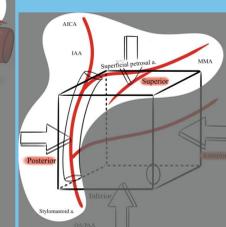


The chorda tympani passes between the incus and malleus, travels with the anterior tympanic artery through the petrotympanic fissure. Within the petrotympanic fissure, the chorda tympani passes over the tensor tympani muscle as it continues its course.

2-2. GSPN/LSPN part



From the tympanic segment, the lesser petrosal nerve accompanies the superior tympanic artery, while from the geniculate ganglion, the GSPN accompanies the superficial petrosal artery. At the meatal segment, there is an anastomosis with the internal auditory artery from the AICA, completing the facial arcade.



At the geniculate ganglion, the superficial petrosal artery runs together with the GSPN.

Lt. combined petrosectomy

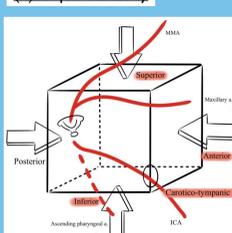


The lesser petrosal nerve passes through the hiatus canal of the petrous bone, along with the superior tympanic artery, entering the tympanic cavity.

Conclusion

- We explained the microanatomy of the tympanic arcade using the embryology of the stapedial artery and cadaveric videos of the facial arcade.
- Visualizing the tympanic cavity as a cube helps to understand its arterial components.

(1) Stapedial artery



(2) Facial arcade

