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Landmarks for the preservation of the middle temporal artery during mastoid surgery: Cadaveric dissection study☆

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ABSTRACT

Importance: The middle temporal artery flap is a vascularized periosteal flap that is highly useful for otologic reconstruction including the middle cranial fossa, mastoidectomy defect, and external auditory canal. The course of the artery is close to the external auditory canal and is easily injured during preliminary exposure and elevation of flaps.
Objectives: To describe the course of the middle temporal artery in relation to the external auditory canal and the superficial temporal artery in order to enhance preservation and use in otologic reconstruction.
Design: Dissection of preserved, injected cadaveric temporal bones.
Setting: Anatomical laboratory.
Participants: Seven cadaveric temporal bones.
Intervention: Temporal bones were dissected in a planar manner to identify the middle temporal artery along the squamous temporal bone to its origin. The superior border of the external auditory canal was divided, horizontally, into thirds to create three measurement points. Distances between the middle temporal artery and the bony portion of the external auditory canal were then determined.
Main outcomes and measures: Horizontal diameter of the external auditory canal, distance from the superior-most border of the external auditory canal to the middle temporal artery, various patterns of the middle temporal artery.
Results: The middle temporal artery branched from the superficial temporal artery in all specimens. Mean horizontal diameter of the external auditory canal was 9.97 mm. Mean distances between the bony portion of the external auditory canal and middle temporal artery for the first, second, and third points along the horizontal diameter of the external auditory canal were 1.57, 2.96, and 4.02 mm, respectively. In at least one specimen, the artery dipped into the external auditory canal.
Conclusions and relevance: The middle temporal artery runs closest to the external auditory canal at the anterosuperior border. To preserve the middle temporal artery for use in reconstruction after otologic surgery, the surgeon should avoid dissection superior to the external auditory canal until the artery is positively identified.

1. Introduction

The temporal pericranial flap based on the middle temporal artery (MTA) is a robust vascularized flap useful for reconstruction of the floor of the middle fossa, resurfacing mastoidecotomy cavity and reconstruction of the external auditory canal. The middle temporal artery flap was first described in 1994 by Black and Kelly. It is thin enough to be used in external auditory canal reconstruction [1], but is robust enough to provide an effective barrier for the repair of middle fossa CSF leaks and encephaloceles. In the canal wall down mastoidectomy cavity, it provides a vascularized layer for overlying epithelialization that will not atrophy with time [2].

The ability to utilize the MTA flap is based on the integrity of its vascular supply. The clinical variability of the MTA can greatly influence the surgeon's ability to isolate and preserve the vascularity of the MTA flap. The middle temporal artery has been described by multiple authors as arising from the superficial temporal artery near the level of the zygoma coursing superiorly at approximately a 45 degree angle along the squamous temporal bone [1,3,4,5]. However, the course of the vessel, beginning from its origin near the external auditory canal, has not been described. This study aims to define the anatomical path of the middle

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temporal artery and related landmarks with reference to the external auditory canal in order to improve the surgeon's ability to expose and elevate the MTA flap.

2. Materials and methods

This study was performed using seven cadaveric temporal bone specimens from International Biological, Inc. (Gross Pointe, MI). The specimen's vessels had been previously injected with color-dyed silicone – red for arteries and blue for veins.

Before dissection, the approximate location and distal path of the middle temporal artery was marked over the epidermis. Wide margins around the approximate distal course of the MTA were used for dissection to account for clinical variability. The specimens were dissected in a planar fashion, layer by layer, under an operating microscope using magnification of 10–20×.

First, the distal middle temporal artery was identified over the squamous temporal bone. Once identified, retrograde dissection was performed towards the external auditory canal, taking care not to disturb the original anatomy of the vessel. The artery was then followed anterior to the EAC to its origin vessel. Fascial, muscular, fat, and epithelial planes that were traversed by the vessel during dissection were documented for this study.

After total skeletonization of the middle temporal artery, detailed photos were taken in the following orientations: 1) upright lateral view with the EAC inferiorly and the MTA coursing superiorly (Fig. 1a), 2) posterior view in the plane of the temporal bone to demonstrate the planar relationship of the MTA as it coursed around the EAC (Fig. 1b). Each photo was taken with a tape-ruler placed near the EAC, with care not to obstruct anatomical structures. The photos were optimized using iPhoto (Version 9.4.3, Apple Inc., Cupertino, CA, USA). From there, Microsoft PowerPoint (Version 14.3, Microsoft Corporation, Redmond, Washington, USA) was used to draw a horizontal line just superior to the superior limit of the EAC. The width of this line was equal to that of the EAC at its widest point. The horizontal line was then divided into thirds. The midline of each third was used to measure the distance from the superior-most border of the EAC to the artery at its original anatomic position (Fig. 2).

Given that the visual categorization of the MTA into two patterns is inherently subjective, the distances from the EAC to the MTA were graphed using seven data points along the artery and compared to a polynomial regression line (order = 2). R [2] was then determined for each cadaveric specimen for greater objectivity in describing the arteries.

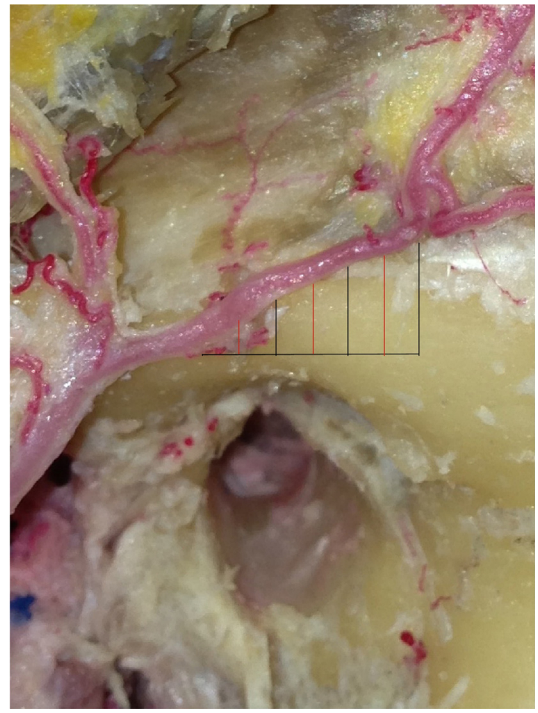

Fig. 2. Diagram used for measurement of distance from middle temporal artery to external auditory canal.

This study did not require IRB approval from the Emory University School of Medicine as it did not involve live human subjects or patient documentation.

3. Results

A total of seven hemifacial cadaveric specimens were dissected. The middle temporal arteries in each of the specimens originated from the superficial temporal artery (STA) anterior to the external auditory canal. The middle temporal artery coursed posterosuperiorly in each specimen towards the external auditory canal, penetrating the temporalis fascia almost immediately after its origin from the STA. In some specimens, the MTA supplied the temporalis fascia with small terminal branches. After penetrating the temporalis fascia, the MTA then immediately pierced the temporalis muscle. Again, in some specimens,

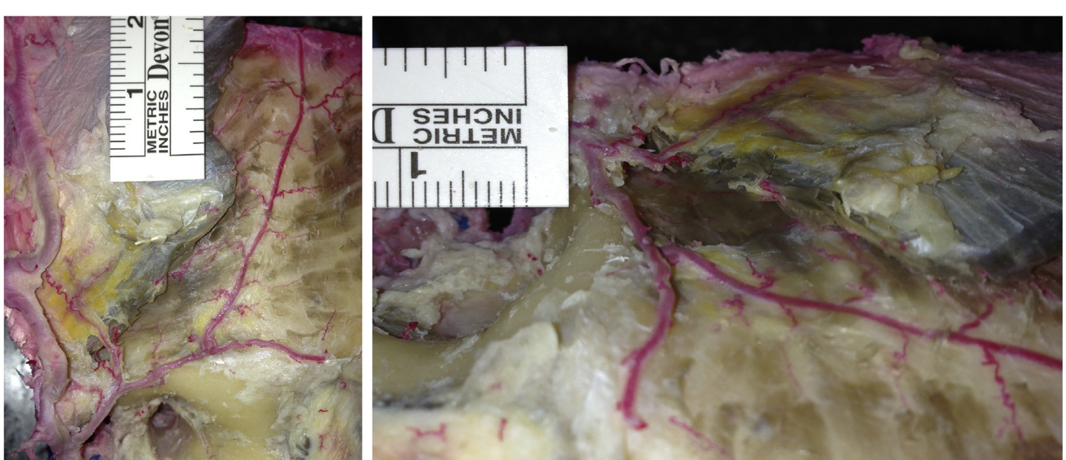

Fig. 1. A) Lateral view. *Arrow* indicates EAC. B) Posterior view to demonstrate relationship with EAC. *Arrow* indicates EAC. EAC = external auditory canal.

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