MIDDLE FOSSA ACCESS TO THE IAC: 3D RECONSTRUCTION AND BONE DISSECTION

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INTRODUCTION

The Middle Cranial Fossa Approach (MFA) to the Internal Auditory Canal (IAC) requires access to the anterolateral skull base, either by removing temporal bone or by drilling the middle fossa. The trans-sphenoidal approach (TSA) is limited by the presence of carotid artery, olfactory nerves, frontal sinuses, and bothersome cerebrospinal fluid leakage. The suprameatal approach (SMA), is limited by the presence of sphenoid sinus, the petrous bone, and the neighboring nerve. The endoscopic trans-sphenoidal and the orbito-sphenoidal approaches (OSA) are limited by the presence of middle turbinate, maxillary sinus, and the inferior turbinate. Finally, there are rare instances where there is a need to access the IAC through the sphenoid sinus.

OBJECTIVES

We aimed to locate the Internal Auditory Canal (IAC) using different approaches. We compared the Middle Fossa Access to the IAC (MF) to the Standard Approach (SA) to visualize the greater axis of the structures studied on each occasion. We project the molded angle into a paper to easily measure the angles (Figs. 6-7).

METHODS

Seventeen cadaveric specimens (14 temporal bones) were dissected in order to evaluate the variability and reliability of the Middle Fossa Access to the IAC (MF) and compare it to the Standard Approach (SA). We measured the angles between: 1) GPN-AE; 2) GPN-BL; 3) IAC-GPN; and 4) BL-AE-GPN. We also determined the distance between the Blau Line and the Greater Petrosal Nerve (GPN) as well as the angle between the Blue Line and the Greater Petrosal Nerve (GPN) (Figs. 3-5).

RESULTS

We identified and labeled all landmarks by etching through different axial slices. To determine these axes we used several different criteria. The IAC axis passed through two specific points: the Bill's Bar (BB) at the level of the lateral vestibular nerve and the middle portion of the largest diameter of the porus. The axis of the GPN was defined by a line crossing between the point where the nerve exits from the geniculate ganglion and its entrance into the Vidian canal (Fig. 2). In order to identify the axis of the AE we performed a 3D reconstruction of the topographic surface of the petrous bone. The reconstruction was initially undertaken in order to visualize the greater axis of the AE (Figs. 3). The binary projection of the superior semicircular membrane parallel at a 110 ° horizontal line with the TCT coil images (Figs. 4-5). As a result of the radiological study, we could observe the presence of the BL axis in the IAC. The distance between the BL and GPN was measured accurately under CT scans. Therefore, in order to calculate angular measurements, each axis was represented by one perpendicular plane to the IAC axis (Fig. 6). We measured the angles of: 1) GPN-BL; 2) IAC-GPN; and 3) BL-AE-GPN. In this study, a comparison between radiological and anatomical measurements and a standardized 3D reconstruction are reported to be determinant factors in the Middle Fossa Access to the IAC (MF) relationship. The main objective was to determine consistent anatomical references to optimize the IAC identification during surgery.

MATERIALS AND METHODS

Seven cadaveric specimens (14 temporal bones) were dissected from May 2007 to December 2008 at the Laboratory of Surgical Neuroanatomy of the Faculty of Medicine, University of Barcelona. To anatomically analyze the Middle Fossa Anatomy, all specimens underwent high-resolution CT scans (1.0 mm slice thickness), followed by a 3D reconstruction of the main structures (Figs. 1-2). Subsequently, a dissection was performed in six of them by etching the IAC approach in a stepwise manner.

A set of angular relations between the axes of the most important MF landmarks were measured radiographically and through dissection. The main axes of Internal Auditory Canal, Arteria Emissaria, Blue Line, Superior Semicircular Canal and Greater Petrosal Nerve was carefully analyzed. The main angles between the axes of: 1) GPN-AE; 2) GPN-BL; 3) IAC-GPN; and 4) IAC-AE; 5) BL-AE-GPN. A specific application from Amira's digital software was used to measure the angular relationships with high precision (Fig. 1).

DISCUSSION

In this study, the Middle Fossa Access to the IAC (MF) is studied by etching different axial slices. To determine these axes we used several different criteria. The IAC axis passed through two specific points: the Bill's Bar (BB) at the level of the lateral vestibular nerve and the middle portion of the largest diameter of the porus. The axis of the GPN was defined by a line crossing between the point where the nerve exits from the geniculate ganglion and its entrance into the Vidian canal (Fig. 2). The distance between the BL and GPN was measured accurately under CT scans. Therefore, in order to calculate angular measurements, each axis was represented by one perpendicular plane to the IAC axis (Fig. 6). We measured the distances of: 1) GPN-BL; 2) IAC-GPN; and 3) BL-AE-GPN. In this study, a comparison between radiological and anatomical measurements and a standardized 3D reconstruction are reported to be determinant factors in the Middle Fossa Access to the IAC (MF) relationship. The main objective was to determine consistent anatomical references to optimize the IAC identification during surgery.

REFERENCES


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4. Williams House proposed his own technique in 1961; tracing the Greater Petrosal Nerve (GPN) from anterior to posterior until its entry point into the geniculate ganglion and its surface on the superior aspect of the petrous bone.  It is rather variable with a tendency to be situated deep and small and the superior aspect of the petrous bone is quite variable. A good preoperative study can help the surgeon to select the best surgical field. We encourage junior neurosurgeons to deeply train with temporal bone MF dissection and also with radiological reconstruction and 3D simulation programs. The dissection morphometry was performed by molding a malleable metal wire upon the surface of the temporal bone resembling the axis of the structures studied on each occasion. We project the molded angle into a paper to easily measure the angles (Figs. 6-7).