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An Important Landmark in the Middle Cranial Fossa Approach: The Arcuate Eminence*

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Orta Kafa Çukuru Yaklaşımında Önemli Bir Landmark: Eminentia Arcuata

Superior semisirküler kanalın (SSC) oluşturduğu, tegmen timpaninin arkasında petröz piramidin ön yüzünde bulunan kemik bir kabartı olan eminentia arcuata (AE) temporal kemiğe orta kafa çukuru yaklaşımlarında önemli bir landmarktır. Eminentia arcuata'nın kolayca tesbit edilemediği durumlarda iç kulak cerrahisinde orta kafa çukuru yolu ile yapılan girişimlerde zorlukla karşılaşılır. Bu nedenle bu bölgedeki kolay tanınan anatomik yapılarla eminentia arcuata'nın ilişkilerinin bilinmesi önemlidir. Çalışmamızın amacı orta kafa çukuru yoluyla yapılan cerrahi yaklaşımda, topografik oryantasyonda önemli olabilecek bu ilişkileri araştırmaktır. Bu çalışma eminentia arcuata'nın yakın anatomik yapılarla ilişkileri hakkında ek bilgiler elde etmek ve superior semisirküler kanalın anatomisini açıklamak üzere 20 erişkin insan kuru temporal kemiği üzerinde gerçekleştirilmiştir.

Anahtar Sözcükler: Eminentia arcuata, orta kafa çukuru cerrahisi, superior semisirküler kanal, iç kulak cerrahisi.

Abstract

The arcuate eminence (AE) which is a bony prominence located on the anterior surface of petrous pyramid and overlies the superior semicircular canal, next to tegmen tympani, is an important landmark in the middle cranial fossa approach (MCF). In most temporal bones, AE can easily be detected, while in some others, it is not prominent; in this situation inner ear surgery through MCF could be difficult. For this reason, the relationship of SSC with neighbour anatomical structures is important for proper localization of AE. The purpose of our study is to investigate these relationships for topographic orientation to the temporal bone in the MCF approaches to inner ear.

Key Words: Arcuate eminence, middle cranial fossa surgery, superior semicircular canal, inner ear surgery.

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Introduction

The arcuate eminence (AE) on the superior semicircular canal (SSC) is found as an important landmark on the anterior surface of the petrous pyramid for surgical approaches of middle fossa.[1,2] A detailed knowledge about the anatomy of the
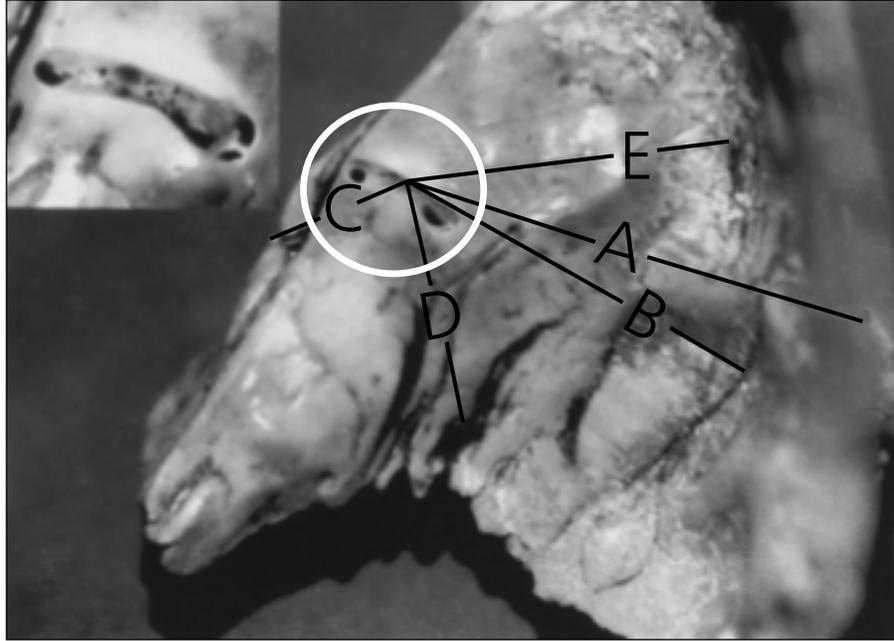
Figure 1. Top view of left temporal bone; eminentia arcuata is drilled to expose superior semicircular canal (SSC). On left top the apex of SSC is highlighted. SSC and its surrounding structure are illustrated. The distances between apex and surrounding structures are indicated by lines A to E. **A:** From apex of the SSC to tabula externa (suprameatal crest), **B:** From apex of the SSC to tabula interna, **C:** From apex of the SSC to apertura of the meatus acusticus internus, **D:** From apex of the SSC to hiatus canalis nervi petrosi majoris, **E:** From apex of the SSC to fissura petrosquamosa.

middle cranial fossa is essential to avoid the damage to underlying important structures during surgery. The anterior surface of the pyramid forming the posterior boundary of the midcranial fossa, is marked by indentations temporal gyri, a trigeminal impression at the apex for the trigeminal ganglion, and the AE protruding from the superior border. At the anterior border two narrow grooves are present for the lesser and greater petrosal nerves each of them rise from their hiatus and go into their canal; the greater petrosal nerve run to the foramen lacerum, whereas the lesser petrosal nerves run to the petrosphenoid fissure. The bone posterior to the arcuate eminence covers the posterior and lateral semicircular canals, and the bone lateral to AE with the tegmen tympani covers mastoid antrum.[3,4] The SSC under the AE is an important landmark in the middle cranial fossa surgical interventions. AE, however, could not be recognised when it is not prominent on the surface. In such case, the topograp-

hic anatomy of the AE is important to identify the exact position of the SSC. This study was performed on 20 adult dry human temporal bones to describe the anatomy of the SSC and to obtain additional knowledge of its relationships to the adjacent anatomical structures.

Materials and Methods

In this study, we used 20 adult dry human temporal bones. Statistical analyses were done by use of the SPSS program paired-t test. The anatomic relationships between the SSC and surrounding structures have been studied by measuring the distances as illustrated in the Figure 1 (except F):

A- Apex of the superior semicircular canal- Tabula externa (supra meatal crest)

B- Apex of the SSC- Tabula interna

C- Apex of the SSC- Apertura of the meatus acusticus internus

D- Apex of the SSC- Hiatus canalis nervi petro-si majoris

E- Apex of the SSC - Fissura petrosquamosa

F- Apex of the AE - opening of the SSC (depth)

Results

In this study, four specimens had non-prominent arcuate eminence (20%), the others had a prominent AE. An arcuate eminence was frequently more discernible in well-pneumatized temporal bones. The average distance from apex of the SSC to the tabula externa (A) was 24.1 mm (SD: 2.37), from apex of the SSC to the tabula interna (B) was 18.47 mm (SD: 2.17), from apex of the SSC to the apertura of the canalis acousticus internus (C) was 13.83 mm (SD: 1.52), from apex of the SSC to the hiatus canalis nervi petrosi majoris (D) was 10.62 mm (SD: 2.10), from apex of the SSC to the fissura petrosquamosa (E) was 16.32 mm (SD: 2.27) and from apex of the AE to one of the opening on the SSC (F) was 1.46 mm (SD: 0.42) in anatomic dissections.

Discussion

When the AE is used as a landmark, more bone could safely be removed from the internal auditory canal, with hearing preservation, during middle cranial fossa approaches since recognition of AE allows accurate localization of the underlying SSC. The SSC is important in all current techniques of middle cranial fossa surgery.[1,5,6] Fisch uses the SSC as the unique essential landmark for identification of the internal auditory meatus.[1] On the other hand House has used SSC as an important but secondary landmark in his surgical approaches, who primarily employed retrograde dissection of the greater superficial petrosal nerve.[2] However, the petrosal nerve can not easily be identified, as proposed by W. House in his middle cranial fossa approaches.[6] Exposure of the blue line of the SSC is the most important step in the inner ear surgery. Fisch recommended an alternative technique taking into account that the internal auditory canal lies within a 60 degree angle from the SSC.[7] With this landmark alone, using a 60 degree angle rendered over the SSC

ampulla, one can define the area of the meatal plane overlying the internal auditory canal.[6,7,8] By remaining within this way the internal auditory canal can be exposed without danger of damage to the facial nerve or basal turn of the cochlea. Wigand, bisects the obtuse angle between the greater petrosal nerve and the blue line of the SSC to find the axis of the internal acoustic meatus.[9]

The facial hiatus is not routinely identified if it is not visible by the time the meatal plane is fully exposed. The facial nerve, basal turn of the cochlea, and ampullated end of the SSC are all within a 4 mm range.[8] Goin has noted that a still narrower channel may lie between the basal turn of the cochlea and the vestibule.[5] For procedures which do not require a total facial nerve exploration, the risk of facial nerve or labyrinthine injury could be reduced by avoiding a perigeniculate dissection.[7] Fisch used as the AE prime topographic landmark for locating the SSC; however, the location of the SSC does not always correspond to the AE. Usually the SSC is anterior to the AE and lies more perpendicular to the superior petrosal sinus. It is dangerous to attempt to find the blue line by direct drilling over the AE because the canal may be superficial or deep.[6,9] We have recently noted that the relationship of the AE to the SSC is variable. We found that the average depth was 1.46 mm (0.64-2.58 mm). The canal is most safely approached posteriorly through the pneumatic cells of the antrum and attic. The anterior technique which has been described by Cohadon et al, and reviewed by Portman et al is utilised. In this technique, the internal auditory canal can be found 10 mm ± 2 mm antero-medial from the SSC on a line drawn from the apex of the canal parallel to the superior petrosal sinus. The SSC is located by dissection beneath the AE.[6]

Kartush et al. reported that AE was evident in 85% of temporal bone specimens. In our anatomic study we could not discern AE in 4 (20%) specimens there is no prominent AE. An AE was discernible in 80% of temporal bones. These specimens had poor pneumatization and depth in the SSC.

In Kartush et al. and our study it is shown that most of the specimens have been associated with well pneumatized temporal bones.

Conclusion

Surgeons rely on landmarks and the relationships between structures to help identify tissues. Because of the potential unreliability of topographic anatomy, the oto-neurological surgeon is not able to orient the floor of the middle cranial fossa in some positions. For this reason, relationships of AE with other anatomical structures in that region is important for its proper localization. To determine the localisation of the SSC when an AE is not evident, these anatomic measurements can be useful for middle cranial fossa orientation. This study presents one way of safely isolating the AE and underlying SSC in this difficult area of dissection.

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