The middle cranial fossa approach: an anatomical study

Abstract

Hearing preservation surgery has become an option for an increasing number of patients with vestibular schwannomas due to diagnosis at an earlier stage. The middle cranial fossa approach represents one such surgical approach for resection of vestibular schwannomas with hearing preservation. We have undertaken an anatomical study of the middle cranial fossa approach to the internal auditory meatus using 20 fresh temporal bones. By simulating the surgical approach it was possible to analyze critically two of the main recognized subapproaches to the internal acoustic meatus. The results confirmed that the angle subtended by the facial nerve and “blue-lined” semicircular canal was much less than 60° but equally important was the degree of individual variability. Furthermore the roof of the geniculate fossa was not infrequently dehiscent. The distance measured from the inner table of the craniotomy to the superior semicircular canal was on average 22 mm, similar to previous reports and utilized by some in their approach in this challenging surgery. From this anatomical study it appears that safe dissection of this area is facilitated by observing the more acute angle between the facial nerve and superior semicircular canal and by taking advantage of the relationship between the inner table and important landmarks.

La voie d’abord de la fosse cérébrale moyenne

Etude anatomiqne

Résumé

Une chirurgie avec conservation de l’audition est devenue une option possible pour un nombre croissant de patients porteurs d’un schwannome vestibulaire du fait d’un diagnostic plus précoce, à un stade moins évolution. La voie de la fosse cérébrale moyenne représente une possibilité d’abord chirurgical en vue d’une telle exérèse du schwannome vestibulaire avec conservation de l’audition. Nous avons entrepris une étude anatomique de la voie de la fosse cérébrale moyenne vers le méat acoustique interne sur 20 rochers frais. En simulant l’abord chirurgical, il a été possible de faire une analyse critique de deux des principales variantes admises de cet abord du méat acoustique interne. Les résultats confirment que l’angle limité par le nerf facial et la ligne bleue du canal semi-circulaire supérieur fait beaucoup moins de 60 degrés mais que la variabilité individuelle est aussi très importante. Par ailleurs, le toit de la fosse du ganglion géniculé était déhiscent de façon non exceptionnelle. La distance mesurée depuis la table interne de la craniotomie jusqu’au canal semi-circulaire supérieur était en moyenne de 22 mm, comparable à celles rapportées auparavant et utilisées par certains lors de leur approche dans cette chirurgie assez difficile. De cette étude anatomique, il ressort que la dissection sûre de cette région est assurée par la prise en compte de l’angle plus aigu entre le nerf facial et le canal semi-circulaire supérieur et en profitant des rapports entre la table interne et des repères importants.
Keywords Vestibular schwannoma · Hearing preservation · Surgical approaches

Introduction

The middle cranial fossa approach is a now well-established approach to the internal acoustic meatus. There are, however, various subapproaches used to identify the facial nerve while preserving auditory function in vestibular schwannoma resection.

The aim of this study was to analyse the two main subapproaches described by House [8] and by Fisch [5]. By mimicking the surgery on temporal bones as closely as possible, the distance from the inner table of the squamous part of the temporal bone to important landmarks was measured. All topographical variations deemed to be of surgical importance were also recorded.

While several studies have investigated the surgical anatomy of the suboccipital approach, there have been few reports on the critical landmarks of the middle fossa approach and their interrelationships and distance measurements.

With the earlier diagnosis of vestibular schwannomas as a result of increased clinical awareness and improved imaging modalities, hearing preservation surgery is becoming a realistic consideration for more patients. The middle fossa approach, which represents one such surgical method of hearing preservation, is one of several options for an increasing number of patients presenting with vestibular schwannomas.

Materials and methods

Twenty fresh adult temporal bones (15 right, 5 left) were obtained for this study. Each was taken with a large portion of squamous part of the temporal bone preserved intact allowing the middle cranial fossa approach to be simulated as closely as possible to the in vivo situation.

Dissection was performed under the operating microscope in a specially designed temporal bone holder. Each fresh bone was secured in such a manner as to reflect the position of the head of the patient undergoing a middle fossa approach in theatre. In this way the operative procedure, angle and view obtained while performing this approach to the internal acoustic meatus were emulated.

A classic craniotomy as for this approach was performed. This involved drilling a 2×3 cm craniotomy two-thirds anterior and one-third posterior to the external acoustic meatus with the lower border at the level of the root of the zygomatic arch. The dura mater was kept intact and the bony window removed. The inferior edge was then enlarged with a bone rongeur to lie flush with the floor of the middle cranial fossa. A dural window was then cut through the craniotomy created for ease, in this respect deviating from the operative procedure. The dura mater was gently elevated over the surface of the temporal bone. The elevation was continued to the foramen spinosum.

Thereafter measurements were taken using a two-point caliper. The angle between the meatus and the superior semicircular canal was determined by first preparing a template of the desired landmarks and then using a protractor to note the requisite angle. The template was made from clear plastic, accurately cutting the plastic to the desired angle. Measurements were first obtained from the inner table at the midpoint of the craniotomy and at the level of the anterior surface of the petrous part of the temporal bone to: (1) the prominence of the arcuate eminence and (2) the foramen spinosum.

Subsequently the superior semicircular canal was blue-lined and the intrameatal facial nerve decompressed. Further measurements were then made (Fig. 1): (1) the inner table to the apex of the superior semicircular canal; (2) the inner table to the center of the geniculate ganglion; the (3) angle between the intrameatal facial nerve and the plane of the superior semicircular canal; (4) the depth of the internal acoustic meatus at the porus (measured from the upper lip of the porus to the anterior surface of the temporal bone).

All other topographical variations were noted which included:

1. dehiscences: (a) roof of the geniculate ganglion, (b) anterior surface of temporal bone;
2. pneumatization: (a) arcuate eminence; (b) superior to the internal acoustic meatus;
3. prominence of the arcuate eminence;
4. length of greater superficial petrosal nerve covered by bone.

Results and discussion

Techniques of identifying the internal acoustic meatus

A variety of techniques are utilized for defining the internal acoustic meatus and avoiding inadvertent damage to surrounding structures.

![Schematic illustration of superior view of left temporal bone displaying relevant structures within.](image-url)