Enlarged Entry Space for the Transpetrosal Approach

ABSTRACT—This report describes the removal of the roof of the external auditory meatus in approaching the tentorial edge, the cerebropontine angle, hippocampal brainstem lesions, and upper clival lesions. This procedure not only provides more space in approaching the tentorial edge or upper brainstem, it also provides a wider entry space for approaching posterior fossa lesions. This approach is also for lesions located lower than the tentorium or in the upper clivus. There is still some confusion about the method for removing the roof of the external auditory canal. We describe the clinical experience and comprehensive surgical procedures used on cadavers. Our extended temporal craniotomy technique using the removal of the roof of the external auditory meatus is a simple, safe, and useful method for obtaining a wider entry space to approach deep perimesencephalic lesions and the posterior fossa.

An important consideration in neurosurgical procedures is avoiding retraction of the brain. Sindou and Fobe¹ reported on the usefulness of removing the roof of the external auditory meatus to avoid the excessive retraction of the temporal lobe or to prevent damage to the venous sinus and Labbé's vein while approaching the tentorial edge. This surgical approach is used for treatment at the tentorial notch, but in our surgical experience with cerebropontine angle lesions, it is also useful for posterior fossa lesions and upper clival lesions. In approaching acoustic neurinomas by the extended middle cranial fossa,²⁻⁴ we found this method to be useful in accessing not only a tentorial lesion but one situ-

ated lower than the tentorium. There has been some confusion about the extent of removal of the roof of the external auditory meatus. We report on the extent of bone removed in cadavers.

METHODS

With a transtentorial transpetrosal approach to a lesion lower than the tentorium, the operative field is very deep and limited, but with a removal of the roof of the external auditory meatus, the entry zone is enlarged and the lesion is more easily accessible (Fig. 1). The

Figure 1. Operative route in the transtentorial transpetrosal approach. The shaded area shows the surgical space of the conventional subtemporal approach to a lesion lower than the tentorium. (A) Available space when using the conventional subtemporal approach. (B) Added surgical space when using the transexternal auditory meatus.

enlargement of the entry zone of the surgical field greatly contributes to the easy insertion of the surgical instruments into the operative field, and the surgeon can feel confident about handling any unexpected bleeding.

After the skin incision, the ear is reflected downward. The skin of the external auditory meatus is separated from the bony structure, while carefully avoiding skin tears. The skin is then pushed down to the lower floor of the external auditory meatus. If the skin is torn, it should be sutured from the external auditory meatus and suture knots should be placed in the external auditory meatus in preparation of suture removal after the operation. Avoid suture from the operative field, because it is difficult to remove the suture knot from the external auditory meatus after the operation, if the suture knots are left between skin and bony structure. A regular low temporal craniotomy is performed (Figs. 2B and 3). The base of the craniotomy reached to the pyramidal bone (Fig. 3). The roof of the external auditory meatus is removed in a wedge shape with a surgical saw. The saw cuts should be placed at the upper one third of the external auditory meatus as indicated (Fig. 2B). After cracking the remaining bony structure at the roof of the external auditory meatus by chisel (Fig. 2A), the roof of the external auditory meatus can be removed *en bloc*. The removed area is indicated in Figure 2, A

Figure 2. The removed area of the roof of the external auditory meatus. the axial view of the skull base shows the removed wedge-shaped bone (A). The medial portion of the removed bone should not extend to the arcuate eminence or middle ear (A). In the lateral view of the skull, the wedge-shaped bone is removed *en bloc* from the external auditory meatus to the temporal base (B).

Figure 3. Conventional craniotomy for the subtemporal approach. The lower margin of the craniotomy window should reach to the temporal base. This makes the removal of the roof of the external auditory meatus easier. The temporal lobe is retracted, and the relationship between the temporal base and the external auditory meatus is shown.

and B. To protect hearing, the removed bone area should not include that near the middle ear and the arcuate eminence should remain undrilled (Fig. 2B). By removing the roof of the external auditory meatus, the temporal base and the external auditory meatus cavity can be combined (Figs. 1 and 2B), and the external auditory meatus cavity can be used as an approach route (Fig. 4). During the removal of the roof of the external auditory meatus, careful resection is recommended to avoid cracking the bone to later secure the fixation of this bone (Fig. 5). For replacing the bone, two or three small

Figure 4. After removal of the roof of the external auditory meatus, injury to the tympanic membrane was avoided. Approach direction is indicated by the arrow.

Figure 5. The relationship of the separated roof of the external auditory meatus and the temporal base is shown. The upper brainstem cannot be seen with the regular subtemporal approach because of the obstruction of the roof of the external auditory meatus.

holes should be made on both removed bone and temporal bone for securing the suture fixation. As Figure 5 indicates, with minimal retraction in the subtemporal approach, it is difficult to identify the upper brainstem because the lesion is behind the roof of the external auditory meatus. When removing the roof of the external auditory meatus, the upper brainstem and posterior cerebral artery can be seen through the external auditory meatus cavity (Fig. 6).

We use this extended temporal craniotomy for patients with acoustic neuroma, posterior cerebral artery aneurysm, tentorial meningioma, and superficial temporal artery and superior cerebral artery bypass. Postoperatively, ear wax transiently increased, but the patients operated on with this method had no additional neurologic deficit after the operation and there were no sequelae or complications related to the procedure.

Figure 7 shows the preoperative (A) and postoperative magnetic resonance image (B) of a patient with tentorial meningioma operated through the external auditory meatus. Temporal lobe retraction was reduced

Figure 6. After the removal of the roof of the external auditory meatus, the posterior cerebral artery, brainstem, and tentorial edge can be identified through the external auditory meatus cavity with minimal retraction of the temporal lobe. P_{2,3}, posterior cerebral artery, P2 and P3 portions.

Figure 7. Preoperative (A) and postoperative (B) magnetic resonance images of a patient with tentorial meningioma operated on with extended temporal craniotomy. The tumor was removed with minimal retraction of the temporal lobe. The arrows show the approach route through the external auditory meatus.

and the tumor was totally removed using the external auditory meatus as an approach route (Fig. 7B).

DISCUSSION

With an upper brainstem or a tentorial lesion, this approach decreases temporal lobe retraction and the risk of venous infarction.¹ But in approaching a lesion lower than the tentorial edge, the base of the temporal lobe and the petrosal bone restrict the lower portion of the surgical field, and the roof of the external auditory meatus is not obstructive. A temporal lobe retraction is required for approaching a lesion that is lower than the tentorium. This excessive retraction of the temporal lobe often induces cerebral contusions or venous infarction.² In approaching an acoustic neurinoma using the extended middle cranial fossa approach²⁻⁵ or a basilar trunk aneurysm using the transpetrosal approach,⁶ resectioning of the petrosal bone is required, but the roof of the external auditory meatus will not be obstructed. But for approaching those lesions situated lower than the tentorial edge,²⁻⁶ removal of the roof of the external auditory meatus is helpful because it enlarges the surgical entry space (Fig. 1).

For the surgeon, the surgical field feels shallow if the entry space is dilated. With the extended middle cranial fossa approach, transpetrosal approach, or conventional subtemporal approach, an enlarged entry space to the surgical field provides easier handling of the neurosurgical instruments, such as the bipolar coagulator or forceps. This technique can enhance transpetrosal approach, middle fossa approach, and conventional subtemporal approach by giving wider and shallower entry for a difficult location. This enlarged operative field is especially useful when unexpected bleeding is encountered from a basilar tip aneurysm or posterior fossa emissary veins. Our method does not take any more time nor does it require special instruments or techniques and can be useful to enlarge the entry space for a deep neurosurgical lesion using the subtemporal approach. In conclusion, the removal of the roof of the external auditory meatus makes the deep-seated operation easier and safer.

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