Modified Petrosal Approach Using Cosmetic Osteoplastic Craniotomy with NEURO-SAT Guidance

Toshihiko Kinjo, Jiro Mukawa, and Naoki Tomiyama

Department of Neurosurgery, University of the Ryukyus School of Medicine, Okinawa

Abstract

The petrosal approach has become a routine procedure for petroclival lesions, but there are some disadvantages such as the time-consuming craniotomy during surgery and depressed deformity of the mastoid area after surgery. To solve these disadvantages, we modified the petrosal approach. Before surgery, the three-dimensional points of the sigmoid sinus and semicircular canals are calculated on computed tomography scan and are input to a computer. A single temporooccipital bone flap is made, and the outer table of bone overlying the mastoid is preserved by forming a narrow groove with a small air drill and cutting the outer table with a chisel. After removing these two free bone flaps, mastoidectomy is performed guided by NEURO-SAT (neuronavigation by computer-assisted frameless stereotaxy). The mastoid bone can be drilled out safely and quickly. The two bone flaps are connected and replaced at the end of the procedure. Osteoplastic petrosal craniotomy guided by NEURO-SAT can achieve a quick craniotomy and satisfactory cosmetic result.

Key words: petrosal approach, frameless stereotaxy

Introduction

The petrosal approach has become a routine procedure for petroclival lesions, with many advantages such as minimal brain retraction and a shorter approach to the lesions. However, there are some disadvantages, as most neurosurgeons are not familiar with mastoidectomy, and petrosal craniotomy requires considerable time. The depressed deformity at the mastoid area may also be unpleasant for the patient after surgery. We describe a modified petrosal approach, cosmetic osteoplastic petrosal craniotomy guided by NEURO-SAT (neuronavigation by computer-assisted frameless stereotaxy), which resolves these problems.

Surgical Technique

On the day before surgery, the three-dimensional points of the sigmoid sinus and semicircular canals are calculated based on a computed tomography (CT) scan and the data are input to a computer. During surgery, a lumbar spinal drainage tube is inserted after satisfactory introduction of anesthesia. The spinal drainage is left in position for several days after surgery to prevent cerebrospinal fluid leakage. Then the patient is placed in a supine position with a pillow under the ipsilateral shoulder. The head is fixed with Sugita's multipurpose head frame.

The skin incision and burr holes are the same as used in Al-Mefty's method. The first burr hole is made just medial and inferior to the asterion. The second hole is made at the squamous and mastoid junction along the projection of the superior temporal line. Two more holes are added to flank the transverse sinus (Fig. 1 upper). A temporooccipital bone flap (large flap) is made using a craniotome. Care is paid not to injure the transverse and sigmoid sinuses.

A narrow groove just posterior to the external auditory meatus is then made by small air drill. The outer table of the mastoid bone flap, 2 x 3 cm (small flap) is formed with a chisel (Fig. 1 lower). Mastoidectomy guided by NEURO-SAT is then performed by air drill while monitoring the points of the sigmoid si-
Representative Case

A 21-year-old female was admitted to our hospital complaining of diplopia. Neurological findings on admission showed incomplete paresis of the trigeminal and abducent nerves on the right side. Magnetic resonance (MR) images showed a huge cystic mass measuring $6 \times 5 \times 4$ cm in the prepontine area and Meckel's cave markedly compressing the brainstem (Fig. 2). She underwent surgery via our modified petrosal approach on the right side. The tumor was almost completely removed (Fig. 3). The postoperative course was uneventful. She was discharged from the hospital 10 days after surgery without neurological deficits. There was no depressed deformity at the mastoid area. Postoperative CT confirmed the extent of craniotomy (Fig. 4). Three-dimensional CT 6 months after surgery showed a well-reconstructed mastoid area (Fig. 5).

Discussion

Our modifications of the petrosal approach are: use of NEURO-SAT to achieve a quick and safe craniotomy; and cosmetic osteoplastic craniotomy to preserve the outer table of bone overlying the mastoid area.
NEURO-SAT designed by Takizawa et al.\textsuperscript{7} is a computer-assisted frameless stereotaxy method which establishes points of localization in the surgical field. We have used NEURO-SAT for intraparenchymatous brain tumors\textsuperscript{5} and more recently for skull base lesions. Bony structures which do not change location throughout surgery provide the best reference points for NEURO-SAT. Our experience with NEURO-SAT for skull base surgery has been encouraging.

Few cosmetic petrosal approaches have been described. Couldwell and Fukushima\textsuperscript{2} described cosmetic mastoidectomy based on removal and replacement of the outer table of the mastoid area. They did not use neuronavigation during surgery. Hakuba\textsuperscript{4} described an osteoplastic mastoidectomy procedure in which the outer table of mastoid bone is cut without dissection from the sternocleidomastoid muscle to avoid deformity and maintain a good blood supply in the mastoid area. However, this technique is relatively complicated for neurosurgeons who are not familiar with this approach. The advantages of our modified approach are quick and safe craniotomy guided by NEURO-SAT and a good cosmetic result achieved by the same simple method as that of Couldwell and Fukushima.

Lastly, the recent development of three-dimensional CT can demonstrate postoperative bony reconstruction in the craniotomy area, and is useful for evaluating pre- and postoperative skull base lesions.

References

Cosmetic Petrosal Craniotomy

1988


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Address reprint requests to: T. Kinjo, M.D., Department of Neurosurgery, University of the Ryukyus School of Medicine, 207 Uehara, Nishihara-cho, Nakagami-gun, Okinawa 903-01, Japan.