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Combined Approach for Lesions Involving the Cerebellopontine Angle and Skull Base: Experience with 30 Cases

Abstract—This article presents a series of 30 patients who underwent a combination of the subtemporal and posterior fossa approaches for exposure of lesions in the clivus or medial petrous region. This combined supra- and infratentorial approach is divided into three variations with progressively greater petrous bone resection to increase exposure of the clivus and medial petrous region. The approach has been divided into petrous bone resection with preservation of hearing (retrolabyrinthine), greater petrous bone resection with sacrifice of hearing (translabyrinthine), and finally maximum petrous drilling with sacrifice of hearing along with transposition of the facial nerve (transcochlear). Ninety-three percent of the cases returned to their premorbid occupations. (*Skull Base Surgery, Volume 1, Number 4, 1991, p. 226*)

The combination of the subtemporal and posterior fossa approaches has been used for many years to gain exposure of lesions in the clivus or medial petrous region. We have divided this approach, popularized by Malis, into three variations with progressively greater petrous bone resection to increase exposure of the clivus and medial petrous region. The approach has been divided into petrous bone resection with preservation of hearing (retrolabyrinthine), greater petrous bone resection with sacrifice of hearing (translabyrinthine), and, finally, maximum petrous drilling with sacrifice of hearing along with transposition of the facial nerve (transcochlear). By combining the skills of a neurosurgeon and a neuro-otologist, the operative exposure can be maximized. We present our experience with 30 cases of the combined approach, its variations, and its indications.

METHODS

The surgical team consists of a neurosurgeon versed in skull base surgery and a neuro-otologist versed in all transmastoid-transcochlear procedures. The patient is positioned supine on the operating table with the head turned parallel to the floor and fixed to the operating table with the Mayfield headholder with appropriate shoulder support.

The incision begins at the level of the zygoma 1 cm anterior to the ear and is continued in a gentle curving fashion around the ear to end just below the mastoid tip (Fig. 1). The incision can be modified by moving the posterior limb of the incision further posterior if greater exposure is necessary. The lateral side of the skull is exposed by retracting the scalp inferiorly with fish hooks. This maneuver exposes the zygoma, lateral temporal bone, external auditory meatus, and mastoid region. If more anterior exposure is required, the external auditory canal is transected and oversewn in two layers.

The neuro-otologist performs the temporal bone approach using the Midas Rex (Midas Rex, Fort Worth, TX) high-speed drill system for the mastoidectomy portion and then changing to the Osteon (Hall Surgical, Santa Barbara, CA) system for more detailed bone removal under the operating microscope. Suction irrigation is used throughout. If hearing is to be preserved, an extended

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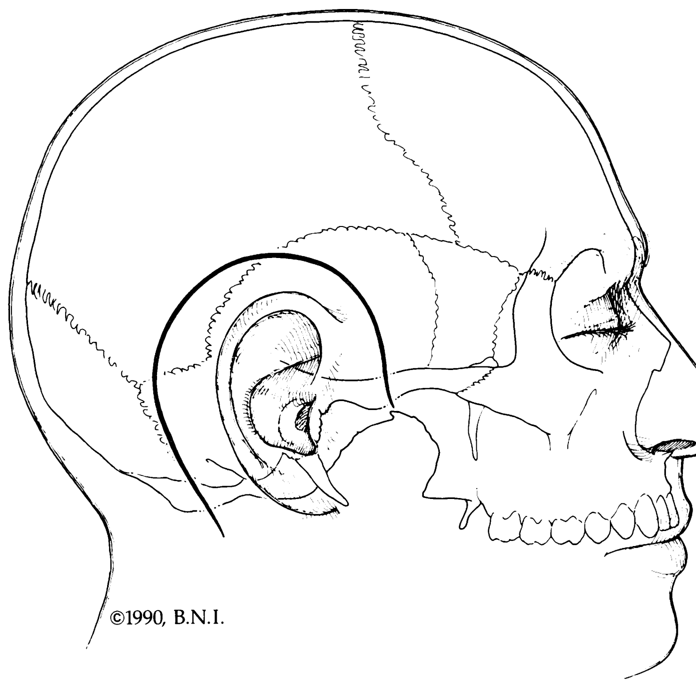

Figure 1. Illustration showing lateral view of the incision starting at the level of the zygoma 1 cm anterior to the ear and continuing in a gentle curving fashion around the ear to the end of the mastoid tip.

retrolabyrinthine approach is done. The posterior and superior semicircular canals are skeletonized, drilling far forward both above and below the otic capsule to expose as much dura as possible (Fig. 2). Bony removal continues over the superior petrosal sinus and the sigmoid sinus. The endolymphatic sac and duct are maintained. The neurosurgeon then turns a craniotomy bone flap of the temporal and occipital region across the transverse sinus.

If greater exposure is required, the translabyrinthine approach is used. This approach will sacrifice any hearing present preoperatively. The same approach is performed as just described. In addition, all three semicircular canals are completely removed, and the posterior half of the internal auditory canal is completely skeletonized (Fig. 3). These maneuvers allow further bone to be removed from the face of the petrous pyramid. Complete removal of the bone overlying the sigmoid sinus, and if necessary the jugular bulb, allows the surgeon to gain more inferior exposure of the clivus. The additional bone removal also allows more working room without requiring retraction of the cerebellum. The posterior external auditory canal and the bone overlying the mastoid segment of the facial nerve should also be thinned. The distal end of the superior vestibular nerve is identified in the vestibule and maintained for easier identification of the facial nerve as it exits the internal auditory canal. Very careful drilling with a diamond tip in this area usually allows one to see the labyrinthine segment of the facial nerve through the thinned bone. The subtemporal-suboccipital craniotomy is then performed.

Finally, the transcochlear approach is used for lesions that require maximum exposure. Once the translabyrinthine exposure is completed, the facial nerve is removed from its bony canal within the temporal bone and is transposed posteriorly after sectioning the greater superficial petrosal nerve (Fig. 4). The dura of the internal auditory canal is used to protect the facial nerve. The entire tympanic portion of the temporal bone is removed with exposure of the periosteum of the temporal mandibular joint. The entire internal auditory canal is then removed followed by the cochlea. The bony separation of the jugular bulb and carotid artery at the skull base is removed, exposing the bulb and being very careful not to injure the 9th, 10th, or 11th cranial nerves. The bony wall of the carotid is then removed almost to the siphon. All bone medial to the carotid is removed, thereby exposing dura to the petrous tip (Fig. 5). If direct carotid exposure is not necessary, a thin rim of bone may be left surrounding the vessel. Bone is also removed from the floor of the middle fossa plate down to the horizontal segment of the carotid artery.

Once the craniotomy flap has been elevated, a large dural surface area is exposed. Standard methods of brain shrinkage are implemented as required. Compressed spectral electroencephalography, auditory brainstem responses (ABR), somatosensory evoked potentials, facial nerve monitoring, and monitoring of any additional cranial nerves are performed on all patients; the ABR is performed only in the contralateral ear if ipsilateral hearing is destroyed. The dura is incised over the temporal lobe at the anterior limit of the craniotomy extending posteriorly to the superior petrosal sinus at least a centimeter below where it enters the sigmoid sinus. If the sigmoid sinus is not to be sacrificed, this incision is brought across the superior petrosal sinus joining with a dural incision in front of the sigmoid sinus. Another incision behind the sigmoid allows the operator to work both in front and in back of the sinus.[1]

The sigmoid sinus can be sacrificed if there is angiographic verification that the major drainage of the sinus is to the contralateral sigmoid sinus and that the conflu-

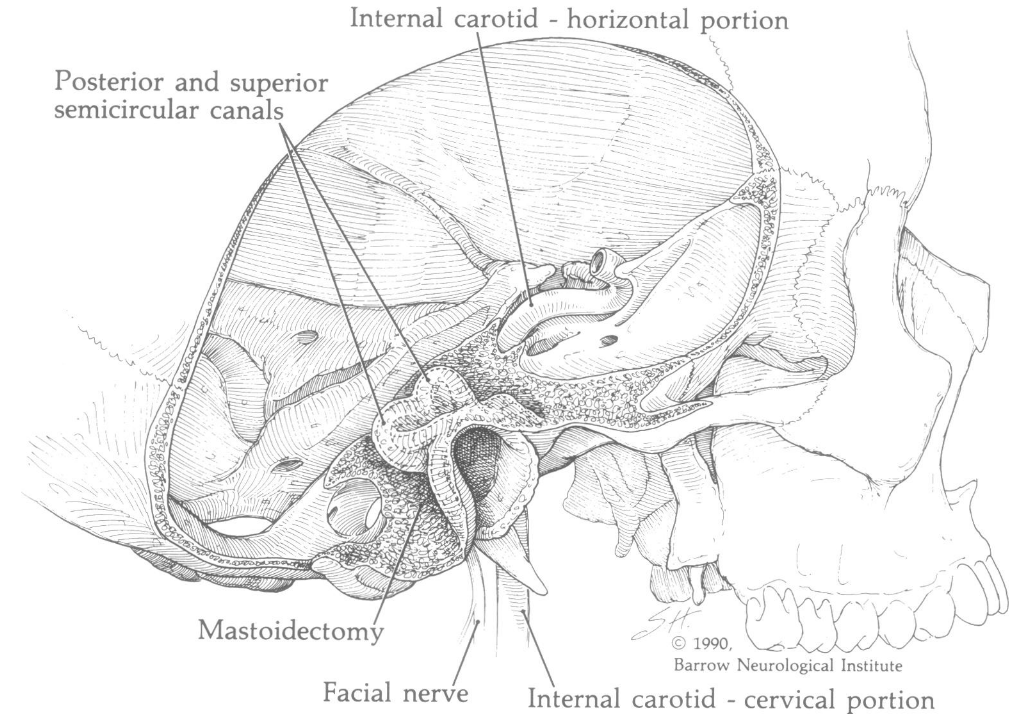

Figure 2. Illustration showing an extended retrolabyrinthine approach with skeletonized posterior and superior semicircular canal and mastoidectomy.

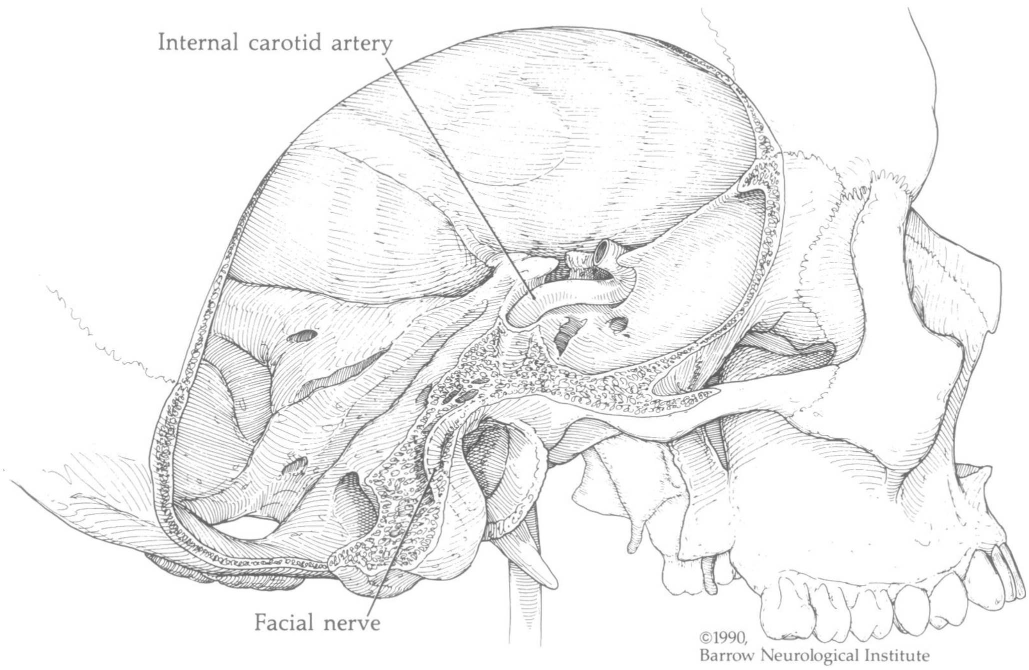

Figure 3. Translabyrinthine approach. All three semicircular canals have been removed.

ence of the sinus is patent. This sacrifice will assure drainage of the ipsilateral vein of Labbé across to the other side. Because the vein of Labbé reliably enters the lateral sinus above the junction of the superior petrosal sinus and the sigmoid sinus, it can be protected maximally by cutting the superior petrosal sinus and the sigmoid sinus and then elevating the cut tentorium along with the base of the temporal lobe. If the sigmoid sinus is kept intact and posterior temporal lobe elevation is required because the tumor has superior extension, the vein of Labbé must be carefully protected as it remains tethered to the skull base by the sigmoid sinus. The tentorium is divided completely to the incisura, being sure to protect the trochlear nerve.

Once the dural incisions have been completed, the

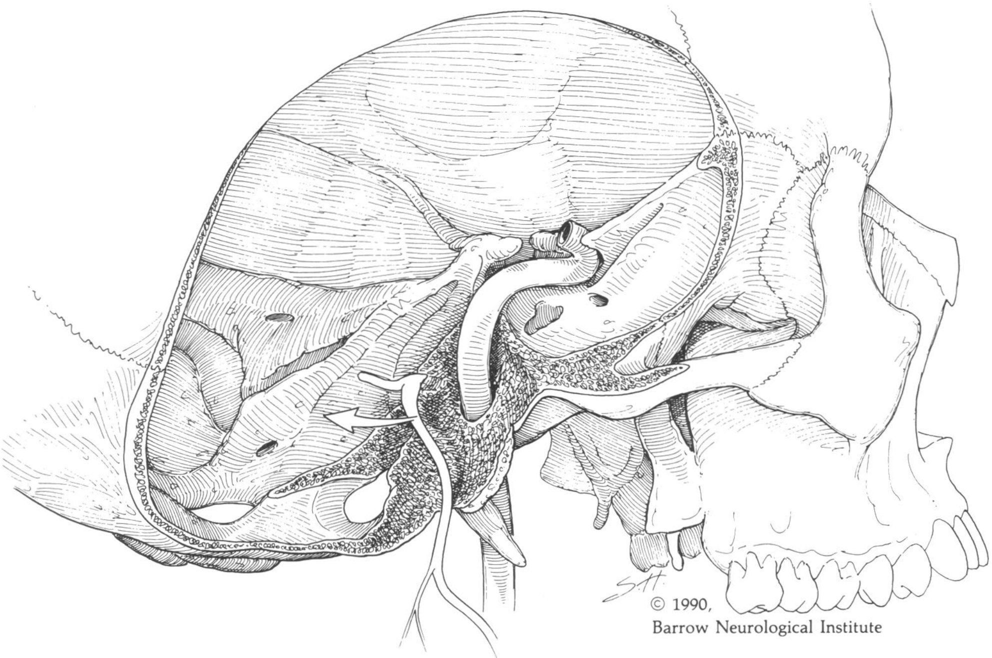

Figure 4. Illustration showing transcochlear approach with posteriorly transposed facial nerve for maximum exposure.

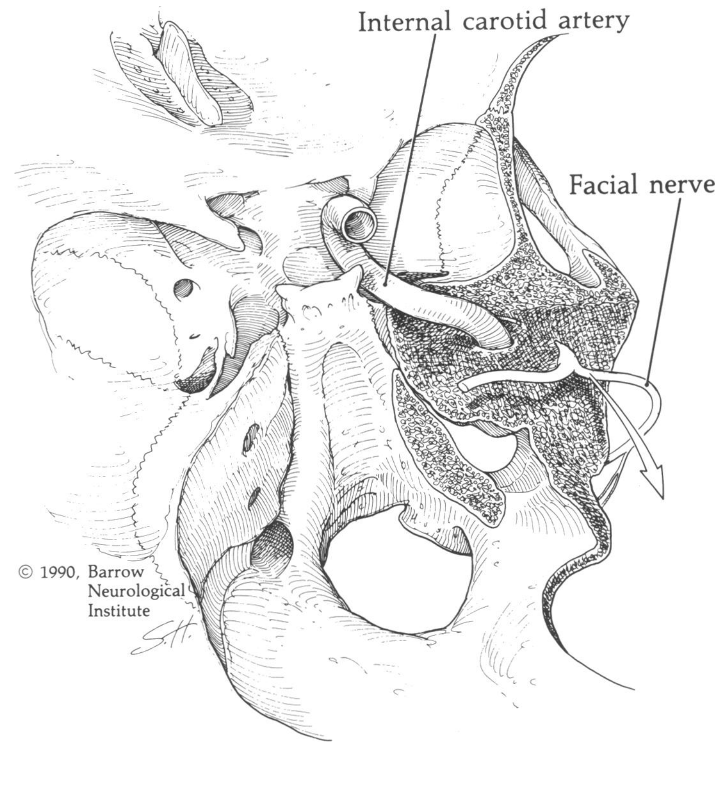

Figure 5. A superoposterior view of the transcochlear approach. The mid-to-lower clivus has been removed. The bony wall of the carotid is then removed almost to the siphon. Bone is also removed from the floor of the middle fossa down to the horizontal segment of the internal carotid artery.

temporal lobe and the cut tentorium are protected by retractors that allow elevation of the base of the temporal lobe while preserving the vein of Labbé (Fig. 6). This exposes the ipsilateral petrous region and entire clivus and cranial nerves. Tumors and vascular lesions are resected or clipped between any adjacent pair of cranial nerves by microsurgical techniques. This approach provides the maximum angle of exposure along the skull base with minimal or no brain retraction.

Closure consists of reapproximating the temporal and occipital dura. Abdominal adipose tissue or temporalis muscle is used to obliterate the temporal bone resection of the exposure. Temporary lumbar spinal drainage is used to prevent cerebrospinal fluid (CSF) leakage.

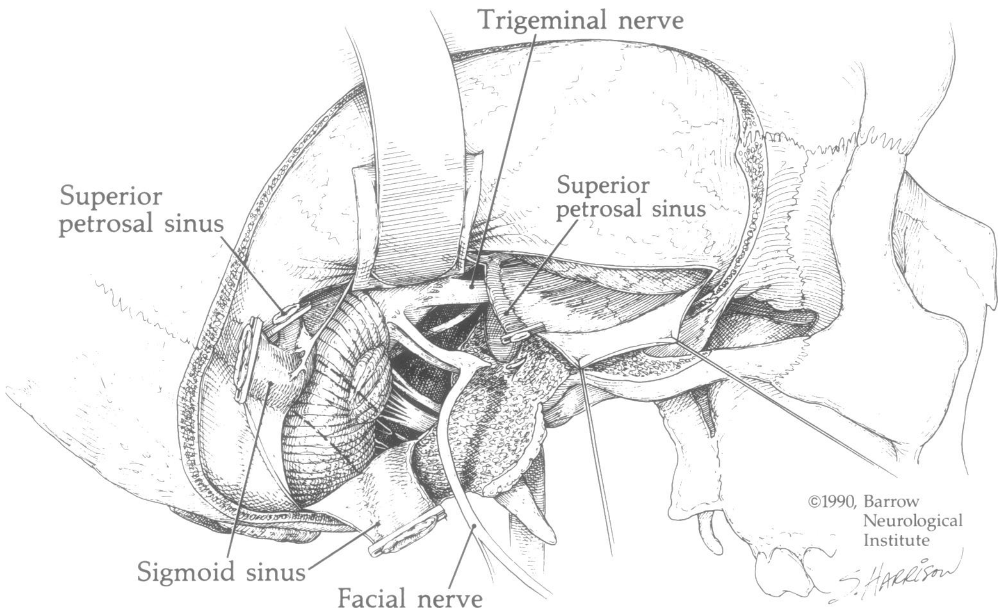

Figure 6. The dural incision has been performed, and retractors have been placed under the temporal lobe and tentorium. The superior petrosal sinus and sigmoid sinus are cut.

RESULTS

Of a total of 114 patients with skull base pathology, 30 have undergone surgery by the combined approach in the past 5 years. There were 22 females and 8 males in the study group. The average age was 41.5 years with a duration of 1.5 years of symptoms. Cranial nerve dysfunction and headache were the most common presenting signs or symptoms (Table 1). The average follow-up for patient evaluation was 1 year.

Most lesions were removed in either one (52%) or two stages (38%). Schwannomas and meningiomas were the most frequently encountered lesions (Table 2). Vascular lesions consisted of brainstem cavernous malformations (4), arteriovenous malformations (AVMs) (2), and aneurysms (2). The most common surgical complications were expected facial nerve paralysis secondary to transposition followed by abducens nerve paralysis and CSF rhinorrhea (Table 3).

Of the 30 patients, 28 have done well and have returned to their premorbid occupations after surgery with total removal of the lesion in most cases. Two patients needed home nursing care. Table 4 summarizes the patient information for each patient in the series.

Extremely difficult surgical lesions in the clivus and/or petrous regions can be treated successfully with acceptable morbidity and mortality by using the combined approach and the operating microscope. Vital neural structures and brainstem vasculature can be visualized and protected as tumors are removed, aneurysms clipped, or AVMs resected. Minimal retraction is required with extensive temporal bone dissection. The combined approach provides exposure from the sphenoid ridge and cavernous sinus to the foramen magnum and anterior cervical spinal cord.

Table 1. Presenting Signs and Symptoms

	%
Most common	
Hearing loss	53
Facial numbness/pain	30
Facial nerve paresis	26
Headache	23
Hemiparesis	20
Gait disturbance	20
Dysmetria	20
Less common	
Abducens paresis	16
Dizziness	16
Diplopia	16
Body numbness	13
Incoordination	13
Seizure	5
Visual field loss	5
Dysarthria	3
Dysthesia	3
Romberg sign	3
Proptosis	3
Nausea	3
Absent corneal reflex	3
Subarachnoid hemorrhage	3
Clonus	3
Dilated pupils	3
XII cranial nerve palsy	3

The history of the combined approach involves advances by both neurosurgeons and neuro-otologists. House[2] described a combined suboccipital-petrosal approach to remove large tumors of the cerebellopontine angle. He described a translabyrinthine approach that extends beyond the sigmoid sinus into the suboccipital area. This exposure achieved a wider view of the cerebellopontine

Table 2. Types of Lesions

Schwannomas	11
Meningiomas	8
Brainstem cavernous malformations	4
Epidermoids	2
Basal cell carcinoma	1
Basilar artery aneurysms	2
Cerebellopontine arteriovenous malformations	2
Total	30

Table 3. Surgical Complications

	%
Facial nerve paralysis	36
Cerebrospinal fluid rhinorrhea	16
Abducens nerve paralysis	13
Facial numbness	6
Hemiparesis	6
Pneumonia	3
Hematoma	3
Shunt infection	3
Decreased gag reflex	3
Sepsis	3
Dysarthria	3
Disorientation	3
Aphasia	3

angle than the translabyrinthine or suboccipital approach alone. The sigmoid sinus could be mobilized either anteriorly or posteriorly or even divided if the contralateral transverse sinus is patient. This combined translabyrinthine-suboccipital exposure is useful for very large tumors. It permits good visualization of the brainstem medially and the facial nerve laterally while minimizing brain retraction. Hemostasis can also be controlled easily with better visualization of the dissection plane between brainstem and tumor with easier access to the major arterial vessels.

Malis[3] reported a combined suboccipital-subtemporal approach that preserved the vein of Labbé by ligating the lateral sinus between the entrance of the vein of Labbé posteriorly and the sigmoid sinus and petrosal sinus anteriorly. After the sinus is divided, the tentorium may be divided along the petrosal apex, sparing the petrosal sinus. The tentorium, lateral sinus, temporal lobe, and vein of Labbé are retracted upward exposing the clivus down toward the foramen magnum. He has used this approach for clival, clivotemporal, and basilar tumors.

House and Hitselberger[4] laster modified these approaches to include the transcochlear approach, which extends the translabyrinthine exposure of the petrous bone forward into the cerebellopontine angle. This modification provides excellent exposure of tumors and the arterial system anterior and anterolateral to the brainstem. Rerouting of the facial nerve is required to gain excellent exposure.

A translabyrinthine-transtemporal approach has been described by Morrison and King[5] for exposing the cerebellopontine angle upward into the middle fossa. The petrous temporal bone is drilled out, and the superior petrosal sinus and tentorium cerebelli are divided. Tumors extending down toward the foramen magnum are now candidates for this approach because visualization is inadequate. Using a similar approach with incomplete labyrinthectomy, Bochenek and Kukwa[6] drilled out the lateral aspect of the petrous bone posteriorly to the level of the compact plate of the sigmoid sinus and medially to the lateral semicircular canal. The tentorium cerebelli was divided keeping the superior petrosal sinus patent. They thought a better exposure of the cerebellopontine angle was gained by this approach than through the labyrinth.

The infratemporal approach can be used as part of the combined approach. In 1977 Fisch[7] first described this approach, which combines a partial posterior and inferior petrosectomy with a cervicofacial approach. This approach provides excellent exposure of the jugular foramen. Pellet et al[8] combined the transcochlear approach of House and Hitselberger and the infratemporal approach of Fisch to create the widened transcochlear approach. Pellet et al's approach involves a petrosectomy that connects the posterior fossa to the superior carotid region. Saddlebag-shaped tumors with a portion in the posterior fossa and another in the infratemporal region can be removed in one stage.

The variations of the combined approach used here were retrolabyrinthine, translabyrinthine, and transcochlear (Figs. 2, 3, 4). The approach went anterior to the horizontal portion of the internal carotid and the siphon depended on the type of lesions, the location of the mass, and the hearing function of the patient. The advantages of minimal cerebellar retraction and positive facial nerve identification in the lateral internal auditory canal are maintained by these approaches and combined with better visualization of the dissection plane between brainstem and tumor. Elevation of the base of the temporal lobe is safely permitted without risk to the vein of Labbé when the cut sigmoid sinus and the cut tentorium are elevated along with the temporal lobe. These approaches can give exposure anterior to the brainstem, toward the middle fossa, and below to the foramen magnum. The major arterial vessels of the brainstem are also accessed more readily for clipping aneurysms, AVM removal, and obtaining hemostasis during tumor removal.

The indications for a particular variation of the combined approach depend on the function of the seventh and eighth cranial nerves, the amount of temporal bone removal needed for exposure, and the amount of brainstem compression. If seventh and eighth cranial nerve function is intact and there is no need for a very anterior exposure to the brainstem, then the retrolabyrinthine approach is adequate. If more anterior visualization of the brainstem is needed or if the patient has little or no hearing, a translabyrinthine approach is needed. For maximum exposure, the transcochlear approach is indicated (Table 5).

Naturally, the routine anterior subtemporal approach or posterior fossa approach should be used when appropriate. Certainly, the anterior subtemporal approach can pro-

Table 4. Clinical Information of 30 Patients Undergoing the Combined Approach

Case	*Age (yr)/ Sex**	*Duration of Symptoms*	*Symptoms/Signs**	*Diagnosis*	*Stages*	*Previous Surgery Before BNI**	*Follow-up*	*Operative Complications**
1	43/F	3 yr	Dizziness Incoordination, CN 6, 7, 8 paresis, nystagmus, hemiparesis	Schwannoma	2	None	10 mo	None
2	25/F	6 mo	L facial numbness, headache, diplopia, L gaze preference, L CN 5, 6 paresis	Meningioma	3	None	6 mo	L facial paresis
3	50/F	1 yr	Dizziness, Facial & body dysthesia	Meningioma	1	None	1 mo	None
4	44/F	5 yr	L CN 8 loss	Schwannoma	2	None	8 mo	L CN 6, 7 paresis
5	32/F	2 yr	Diplopia, L CN 6, 7, 8 paresis, incoordination	Epidermoid	1	None	3.5 yr	CSF leak
6	60/F	14 yr	Headache, L CN 7, 8, L facial pain	Basal cell carcinoma	1	None	3.2 yr	None
7	26/F	6 mo	R eye protrusion, incoordination, diplopia, hearing loss, papilledema	Schwannoma	1	None	1 mo	None
8	20/F	2 mo	L side numbness, headaches, nausea, dizziness, nystagmus, absent corneal reflex	Meningioma	5	None		None
9	23/F	2 wk	R facial numbness, L body numbness, R dysmetria, incoordination	Cavernous malformation	1	None	1.5 yr	None
10	54/F	3 days	R facial numbness, incoordination, R hearing loss, nystagmus	Schwannoma	2	Suboccipital	20 mo	Posterior fossa hematoma; decreased gag reflex
11	36/F	3 mo	Hearing loss, clonus, nystagmus, dilated pupil	Schwannoma	3	None	2.5 yr	None
12	41/F	3 mo	Headaches, hearing loss, hemiparesis	Meningioma	2	None	9 mo	Decreased gag reflex, R CN 5, 6, 7 paresis, pneumonia
13	64/F	2 mo	Headache, incoordination	Meningioma	1	None	4 mo	R CN 5, 6, 7 paresis
14	63/F	6 mo	Deafness	Schwannoma	2	Subtemporal	2.5 yr	R CN 7 paresis, CSF leak
15	55/F	2 days	Headache, hearing loss, incoordination, dysmetria	Schwannoma	2	None	5 mo	Sepsis, CN 6, 7 paresis
16	30/F	2 mo	Numbness, headache	Meningioma	1	None	1 mo	CN 7 paresis
17	62/F	1 yr	Hearing loss	Epidermoid	1	None	1 mo	CN 7 paresis
18	27/F	1 mo	Seizure	Schwannoma	2	Temporal craniotomy	1 mo	CSF leak, CN 7 paresis

Table 4. *Continued*

Case	Age (yr)/ Sex*	Duration of Symptoms	Symptoms/Signs*	Diagnosis	Stages	Previous Surgery Before BNI*	Follow-up	Operative Complications*
19	49/F	4 mo	Numbness	Schwannoma	2	Temporal craniotomy	1 mo	CSF leak, CN 7 paresis
20	58/M	SAH followed by physician recommending no surgery	Severe hemorrhage with loss of consciousness, hemiparesis, incoordination, dysmetria	Midbasilar artery aneurysm (2.5 cm)	1	None	4 yr	None
21	5 mo/M	3 mo	Seizures, L hemiparesis, R CN 5, 7 paresis	Cerebellopontine AVM	1	None	5 yr	None
22	32/M	3 yr	L hemiparesis, L CN 7 and 12 paresis	Midbrain cavernous malformation	1	2 prevous craniotomies	Shunt infection, death 5 mo after surgery	None
23	33/M	2 wk	L hemiparesis, R CN 5, 6, 7 paresis, bilateral dysmetria, dysarthria, incoordination	Cerebellopontine AVM	2	None	8 mo	None
24	68/F	3 mo	L hemiparesis, dizziness, headache, R hearing loss	Anterior inferior communicating artery	1	None	Less than 1 mo	CSF leak
25	39/M	6 wk	Hemiparesis, incoordination, R CN 5, 6, 7, 8, 9 dysfunction, nystagmus	Pontine cavernous malformation	1	Suboccipital craniotomy for removal of pontine hematoma CN 7-12 anastomosis	Less than 1 mo	None
26	35/M	6 mo	Dysmetria, diplopia, decreased night vision, papilledema	Schwannoma	2	None	1 mo	None
27	30/M	6 mo	Diplopia, papilledema, deafness, dizziness	Schwannoma	1	Craniotomy	1 mo	Mild CN 7 paresis
28	48/M	9 yr	CN 7 paresis, facial numbness, deafness	Cavernous malformation	1	Craniotomy for evacuation of pontine hemorrhage	3 mo	None
29	58/F	2 mo	Facial numbness, ataxia, visual field cut	Meningioma	2	None	3 mo	Aphasia, mild hemiparesis
30	59/F	1 yr	Disequilibrium, incoordination, hearing loss	Meningioma	1	Craniotomy	3 mo	None

*BNI: Barrow Neurological Institute; F: female: M: male: CN: cranial nerve; R: right; L: left; CSF: cerebrospinal fluid; SAH; subarachnoid hemorrhage; AVM: arteriovenous malformation.

Table 5. Extent of Temporal Bone Dissection

1. Extended retrolabyrinthine—preserves hearing
2. Translabyrinthine—sacrifices hearing
3. Transcochlear—facial nerve routed posteriorly and internal carotid artery exposed in temporal bone

vide exquisite exposure for tumors of the upper third of the clivus without significant lateral petrous extension, just as the suboccipital approach is adequate for tumors in the posterior fossa that do not extend into the middle fossa or that do not extend far to the contralateral side. However, for tumors that include the middle portion of the clivus or that cross the medial petrous ridge and that commonly include posterior and middle fossa extension with tumor extending into Meckel's cave and the cavernous sinus, the combined approach offers maximum exposure with minimal retraction.

Although the sacrifice of the sigmoid sinus remains optional, it does permit further elevation of the temporal lobe than is otherwise possible without stretching the vein of Labbé. As long as appropriate venous drainage is verified beforehand, there does not appear to be any risk associated with sacrificing the sigmoid sinus.

Removing the petrous bone can help increase the exposure into the cerebellopontine angle. The translabyrinthine approach can give a more direct anterolateral approach to the cerebellopontine angle, whereas the retrolabyrinthine approach allows entry into the cerebellopontine angle anteriorly to the sigmoid sinus, with less cerebellar retraction and preservation of hearing. The transcochlear approach into the cerebellopontine angle and clivus with the combined approach gives additional exposure anterior to the brainstem. This involves extending the translabyrinthine approach anteriorly by drilling away the bone of the cochlea and exposing the dura over the petrous pyramid anteriorly and medially to the internal auditory canal. Exposure to the most anterior aspect of the cerebellopontine angle is thereby gained. With the choice of the retrolabyrinthine approach, hearing may be preserved. However, this approach requires more retraction. The translabyrinthine approach preserves function of the seventh cranial nerve but sacrifices hearing and has an increased risk of CSF leak. This variation provides greater exposure through greater petrous bone resection. The transcochlear variation provides maximal petrous bone resection for maximal exposure. The disadvantages include the sacrifice of hearing, increased risk of CSF leak, and at least a 6-month period of seventh nerve paralysis or paresis with the possibility of incomplete seventh nerve recovery.

Whether the petrous portion of the internal carotid artery is completely exposed depends on the type of lesion and its location.

The facial nerve can be transposed in several ways. The nerve can be completely removed from its canal, along with dissection of the parotid gland for anterior transposition. Brackmann[9] moves the nerve anteriorly along the surrounding soft tissue of the stylomastoid foramen. The nerve, which is not completely transposed, is left with better postoperative function. Most patients have a postoperative facial paresis; however, function returns either completely or almost completely after several months. Proper use of intraoperative monitoring techniques can help preserve facial nerve function. Facial paralysis from interruption of the nerve may be restored by facial anastomosis or interposition nerve grafting or hypoglossal-facial anastomosis.

Facial nerve injury was the highest postoperative complication, as expected from surgical manipulation (Table 3). The mortality rate was zero. The morbidity and mortality after surgery for this series compare favorably with previously published reports. Before the use of the operative microscope, operative mortality was over 50% for clival and petrous meningiomas.[10] With the use of the microscope, mortality has dropped to 11% in Mayberg's and Symons's[10] series and 0% in Al-Mefty's et al's[11] series. As would be expected, cranial nerve deficits from surgical manipulation are high after these procedures. Both Mayberg and Symon[10] and Al-Mefty et al[11] report cranial nerve deficits in more than 50% of their patients.

Based on our experience, the combined approach and its appropriate variations are recommended for skull base pathology involving the clivus, petrous bone, and adjacent areas. These approaches provide access to the lesion so they can be treated effectively with acceptable morbidity and mortality.

REFERENCES

1. Samii M, Ammirati M, Mahran A, et al: Surgery of petroclival meningiomas: Report of 24 cases. Neurosurgery 24:12–17, 1989
2. House WF: Translabyrinthine approach. In House WF, Luetje CM, eds: Acoustic Tumors, vol. 2: Management. Baltimore: University Park Press, 1979, pp 43–87
3. Malis LI: Surgical resection of tumors of the skull base. In Wilkins RH, Rengachary SS, eds: Neurosurgery. New York: McGraw-Hill, 1985, pp 1011–1021
4. House WF, Hitselberger WE: The transcochlear approach to the skull base. Arch Otolaryngol 102:334–342, 1976
5. Morrison AW, King TT: Experiences with a translabyrinthine-transtentorial approach to the cerebellopontine angle. Technical note. J Neurosurg 38:382–390, 1973
6. Bochenek Z, Kukwa A: An extended approach through the middle cranial fossa to the internal auditory meatus and the cerebellopontine angle. Acta Otolaryngol (Stockh) 80:410–414, 1975
7. Fisch U: Infratemporal fossa approach for extensive tumors of the temporal bone and base of the skull. In Silverstein H, Norell H, eds: Neurological Surgery of the Ear. Birmingham, AL: Aesculapius, 1977, pp 34–53
8. Pellet W, Cannoni M, Pech A: The widened transcochlear approach to jugular foramen tumors. J Neurosurg 69:887–894, 1988
9. Brackmann DE: The facial nerve in the infratemporal approach. Otolaryngol Head Neck Surg 97:15–17, 1987
10. Mayberg MR, Symon L: Meningiomas of the clivus and apical petrous bone. Report of 35 cases. J Neurosurg 65:160–167, 1986
11. Al-Mefty O, Fox JL, Smith RR: Petrosal approach for petroclival meningiomas. Neurosurgery 22:510–517, 1988