potential for catastrophic injury to the ICA. Certainly these approaches have their indications and are essentially a variation of the POTS approach, which is suitable for addressing minimally invasive, minimally vascularized JF pathology. Rarely these types of approaches can be considered for early Class C1 TJPs, with predominantly posterior disease, and Class B3 tumors.[26] In contrast with Pensak et al., the majority of TJPs do require an ITFA to facilitate safe removal of the tumor.[26,27]

Circumferential dissection of the facial nerve in its vertical segment with preservation of a thin bony coverage is referred to as a fallopian bridge (see Chapter 13). This can be associated with either preservation or removal of the EAC and middle ear structures[27] and allows access to the jugular bulb on either side of the facial nerve.[28] This technique limits anterior control, and there remains a small risk of facial nerve injury due to possible fracture of the fallopian bridge.

Facial nerve mobilization also allows safe removal of the styloid process and complete removal of the tympanic bone, which is invariably infiltrated in TJP. This would provide for optimal control of the upper parapharyngeal space, the ICA, and the lower cranial nerves (LCNs). The true results of facial function following rerouting must be analyzed in comparison with tumor recurrence rates, and with associated morbidity when the facial nerve is not mobilized. We strongly feel that the relatively mild facial dysfunction associated with anterior rerouting from the geniculate ganglion is a small price to pay for improved access that provides definitive vascular control and ultimately reduces recurrence rates.[29]

A purely retrosigmoid approach is commonly used to manage lower cranial nerve schwannomas and posterior fossa meningiomas, but does not allow safe removal of tumor once it has extended into the jugular foramen and this represents a common reason for recurrence. We routinely use the retrosigmoid, retrolabyrinthine approach for vestibular schwannomas; with a more anterior dissection to fully expose the dura between the labyrinth and jugular bulb, additional access can be gained for resection of those rare LCN schwannomas that remain purely cisternal but extend toward the jugular foramen.

Preservation of the jugulosigmoid system has also been described for JF pathology, when it has been compressed but not invaded. The suprajugular approach, essentially a presigmoid, infralabyrinthine approach, involves dissection of the infralabyrinthine air cell tract, with an opening of the dura between the labyrinth and the jugular bulb, allowing improved access up to the jugular foramen.[24] The pneumatization pattern of the temporal bone plays a large role in the amount of room that can be gained in this area. Evidently, while preservation of the jugulosigmoid system has been described for dumbbell tumors of the LCN,[30] this might not allow complete removal of the tumor.

As mentioned, a transjugular approach is almost always necessary in management of JF pathology and is essential to allow excision of lesions that have true extension into the jugular foramen and further into the parapharyngeal space.[31] It is only in the rare case where sacrifice of the jugulosigmoid system is not possible as detected on preoperative assessment that these more conservative measures should be considered.

The use of the far or extreme lateral approaches with various extensions has been proposed for the routine approach to the JF to preserve the middle ear and leave the facial nerve in situ, and even avoid drilling the petrous bone at all.[7,11,13,32–36] The far-lateral approach was initially developed to access lesions of the craniocervical junction and ventral lower brainstem to limit brainstem retraction; pathology without significant involvement of the temporal bone.[24,33,37,38]

The basic approach entails removal of the lateral process of the atlas plus or minus medial mobilization of the vertebral artery, and a suboccipital craniotomy with removal of the posterior half of the arch of the atlas. This in itself provides limited access to the poststyloid parapharyngeal space. Further exposure is then gained by variable removal of bone of the occipital condyle and or surrounding bone. These are often referred to as trans-, supra-, and paracondylar extensions.[7,33–35,39–41] From this approach, medial mobilization of the vertebral artery is required to safely drill the posteromedial one-third of the occipital condyle, and reduce the jugular tubercle lying superiorly, which then gives inferomedial access to the jugular bulb.

In reality these approaches, on their own, limit control of the intrapetrous carotid and the ability to widely remove infiltrated bone. Access remains medial to the facial nerve, and is limited superiorly by the EAC. The true advantage of these approaches lies in improved exposure of the intradural extension.

Salas et al. described an extreme-lateral transjugular approach for TJP, combining a "complete mastoidectomy," mobilization of the facial nerve from the second genu, and partial removal of the occipital condyle, to overcome some of these limitations.[36]

Removal of the lateral process of the atlas and transposition of the vertebral artery is unnecessary, however, unless vertebral artery involvement is present. In addition, important cerebral drainage occurs though the vertebral venous system (as discussed in Chapter 2), and obliteration of the venous plexus around the vertebral artery, as is required in mobilization, may risk impairment of venous outflow.

The advantage of the transcondylar transtubercular removal can be gained by extending bony dissection in a superior to inferior direction. The vertebral artery is not placed at risk if bony dissection is limited to the portion of the occipital condyle superior to the hypoglossal canal.

In summary these techniques are useful adjuncts to the ITFA, especially in Class C2–C4 tumors, and this is the technique that we have developed and that we routinely adopt in Class C2–C4 tumors.

The subtemporal infratemporal approach was initially described by Sekhar for the removal of extradural lesions of the mid to upper clivus and involvement of the petrous ICA.[42] It is a preauricular approach that, when used in isolation, represents an anterior approach to the JF. While it avoids the necessity to reroute the facial nerve, it requires resection of the mandibular condyle and mobilization of the petrous ICA, and gives limited exposure to the bony margins of the JF. It has no role as a sole approach for lesions of the JF. In combination with an ITFA it is essentially the same as an infratemporal fossa approach type B (ITFB) and is employed to control the area medial to the horizontal intrapetrous ICA.[2,5]

The Gruppo Otologico Approach to Tympanojugular Paragangliomas

We emphasize that the degree of ICA involvement is the critical point in determining the surgical approach.[43–46] The most accurate way in which to communicate the degree of ICA involvement is to stage TJP using the Fisch classification. It is our opinion that only selected cases of Class C1 tumors can be safely and adequately addressed without rerouting of the facial nerve. We present the classic ITFA for Class C1 and certain Class C2 tumors and the ITFA with extensions as a simplified and unified paradigm in the approach to manage Class C2–C4 tumors.

Infratemporal Fossa Approach Type A

(See also Chapter 2.)
This approach is designed to allow access to the JF area, the infralabyrinthine and apical compartments of the petrous bone, the vertical segment of the ICA, and the upper jugulocarotid space (**Fig. 9.1a**). The approach is designed primarily for extensive extradural lesions involving these areas. The key point in this approach is the anterior transposition of the facial nerve, which provides optimal control of the infralabyrinthine and jugular foramen regions, as well as the vertical portion of the ICA (**Fig. 9.1b**). The other structures that prevent lateral access to these areas are shown in **Fig. 9.1c**. Besides the facial nerve they include the tympanic bone, the digastric muscle, and the styloid process. These structures are removed to allow unhindered lateral access.

Surgical Anatomy

- The mastoid segment of the facial nerve is centered on the jugular bulb. In 60% of cases, half or more of the bulb lies anterior to the vertical plane of the nerve (**Fig. 9.2**).
- When they exit from the skull base, the glossopharyngeal nerve is the most lateral, while the hypoglossal nerve is most medial. The hypoglossal nerve turns inferiorly to run together with the vagus nerve for a short distance in the upper neck (**Fig. 9.3**).
- The glossopharyngeal nerve is seen crossing the ICA anteriorly (**Fig. 9.3**).
- More inferiorly, the hypoglossal nerve crosses the artery to go toward the tongue. The vagus nerve is seen coursing between the internal jugular vein and the ICA (**Fig. 9.4**). The accessory nerve crosses the lateral surface of the internal jugular vein and travels posteriorly.
- In half of cases, the spinal accessory nerve crosses medial to the internal jugular vein. In all cases, it passes anterolateral to the transverse process of the atlas (**Fig. 9.5**).
- Note the close relation between the vertebral artery and the internal jugular vein. TJPs with considerable extension into the neck may well involve the artery (**Fig. 9.5**).
- The styloid process and its muscles separate the external carotid artery laterally from the ICA medially.
- The condylar emissary vein drains into the jugular bulb in 70% of cases, and the vein often has an intimate relation to the lower cranial nerves (X–XI) at their exit from the JF (**Fig. 9.6**).
- After its origin from the external carotid artery, the occipital artery runs backward, lateral to the internal jugular vein and the accessory nerve in the neck. The ICA angles medially at its ingress into its bony canal at the skull base. The jugular bulb curves laterally before its exit into the neck to form the internal jugular vein (**Fig. 9.7**).
- **Fig. 9.1c** shows the structures passing lateral to the great vessels at the base of the skull: the facial nerve, and the styloid process and its attached ligaments and muscles, as well as the posterior belly of the digastric muscle and sternocleidomastoid muscle. For extensive jugular foramen tumors extending down to the neck, as in Class C TJP, adequate control of this region from the lateral to medial aspect requires these structures to be either sacrificed or transposed.

Surgical Steps

1. A postauricular skin incision is made (**Fig. 9.8**).
2. A small, anteriorly based musculoperiosteal flap is elevated to help in closure afterward. The EAC is transected as before (**Fig. 9.9**).
3. The facial nerve is identified at its exit from the temporal bone (**Fig. 9.10**). The main trunk is found at the perpendicular bisection of a line joining the cartilaginous pointer to the mastoid tip. The main trunk is traced in the parotid until the proximal parts of the temporal and zygomatic branches are identified.
4. The posterior belly of the digastric muscle and the sternocleidomastoid muscle are divided close to their origin. The internal jugular vein and the external and internal carotid arteries are identified in the neck (**Fig. 9.9**). The vessels are marked with vessel loops.
5. The skin of the external auditory canal, the tympanic membrane, the malleus, and incus are removed.
6. A canal wall down mastoidectomy is performed, with removal of the bone anterior and posterior to the sigmoid sinus. The facial nerve is skeletonized from the stylomastoid foramen to the geniculate ganglion. The last shell of bone is removed using a double-curved raspatory. The suprastructure of the stapes is preferably removed after cutting its crura with microscissors (**Fig. 9.11**).
7. The inferior tympanic bone is widely removed, and the mastoid tip is amputated using a rongeur. A new bony canal (arrow in **Fig. 9.12**) is drilled in the root of the zygoma superior to the Eustachian tube.
8. The facial nerve is freed at the level of the stylomastoid foramen using strong scissors. The soft tissues at this level are not separated from the nerve (**Fig. 9.13**).
9. The mastoid segment is next elevated using a Beaver knife to cut the fibrous attachments between the nerve and the fallopian canal. The tympanic segment of the nerve is elevated carefully, using a curved raspatory, until the level of the geniculate ganglion is reached.
   A nontoothed forceps is used to hold the soft tissue surrounding the nerve at the stylomastoid foramen, and anterior rerouting is carried out (**Fig. 9.14**).
10. A tunnel is created in the parotid gland to lodge the transposed nerve (**Fig. 9.15**). The tunnel is closed around the nerve using two sutures.
11. A closer view (**Fig. 9.16**) shows the facial nerve in its new bony canal, just superior to the Eustachian tube. The nerve is fixed to the new bony canal using fibrin glue.
12. Drilling of the infralabyrinthine cells is completed, and the vertical portion of the ICA is identified (**Fig. 9.17**).
13. The mandibular condyle is separated from the anterior wall of the external auditory canal using a large septal raspatory. The Fisch infratemporal fossa retractor is applied, and the mandibular condyle is anteriorly displaced, with care being taken

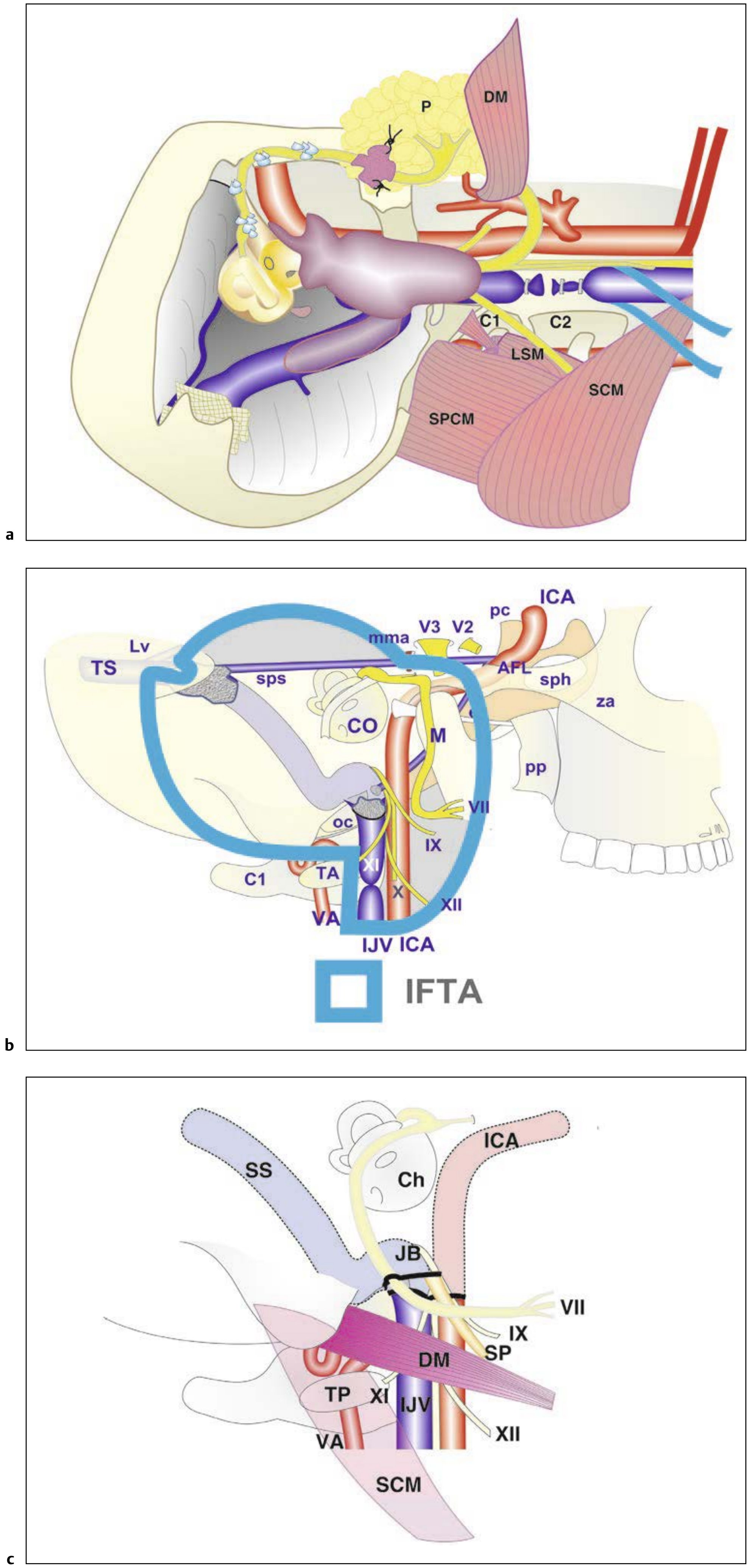

Fig. 9.1a–c Illustrations for infratemporal fossa approach type A (ITFA).
a An illustration of the surgical view in ITFA.
b An illustration of the surgical limit in ITFA.
c An illustration of obstacles to approaching the jugular bulb.

AFL anterior foramen lacerum
C1 atlas
C2 axis
Ch cochlea
DM posterior belly of the digastric muscle
ICA internal carotid artery
IJV internal jugular vein
JB jugular bulb
LSM levator scapulae muscle
Lv vein of Labbé
mma middle meningeal artery
M mandible
OC occipital condyle
P parotid gland
pc clinoid process
pp pterygoid plate
SCM sternocleidomastoid muscle
SP styloid process
SPCM splenius capitis muscle
sph sphenoid sinus
sps superior petrosal sinus
TP transverse process of the atlas
TS transverse sinus
V2 maxillary branch of the trigeminal nerve
V3 mandibular branch of the trigeminal nerve
za zygomatic arch
VA vertebral artery
VII facial nerve
IX glossopharyngeal nerve
XI spinal accessory nerve
XII hypoglossal nerve

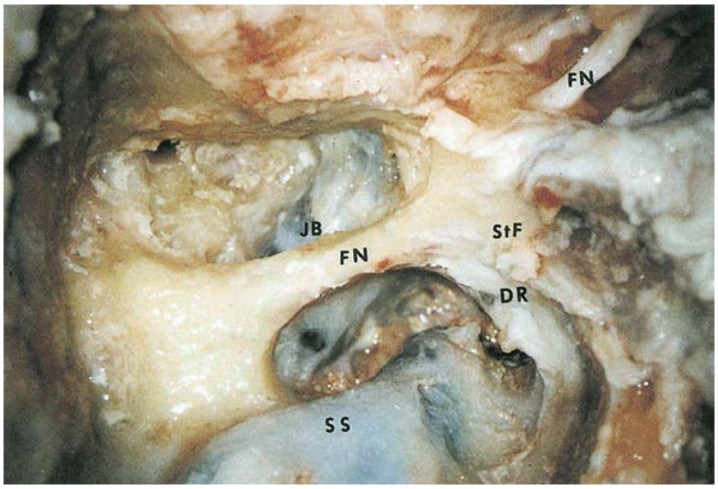

Fig. 9.2

DR	digastric ridge	SS	sigmoid sinus
FN	facial nerve	StF	stylomastoid foramen
JB	jugular bulb		

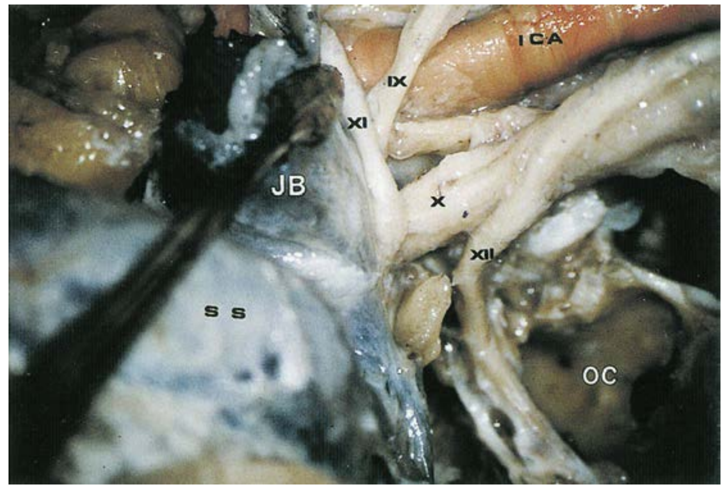

Fig. 9.3

ICA	internal carotid artery	IX	glossopharyngeal nerve
JB	jugular bulb	X	vagus nerve
OC	occipital condyle	XI	spinal accessory nerve
SS	sigmoid sinus	XII	hypoglossal nerve

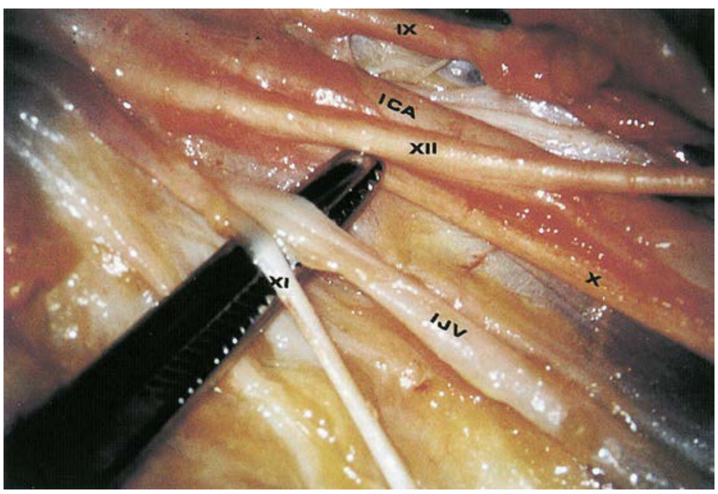

Fig. 9.4

ICA	internal carotid artery	X	vagus nerve
IJV	internal jugular vein	XI	spinal accessory nerve
IX	glossopharyngeal nerve	XII	hypoglossal nerve

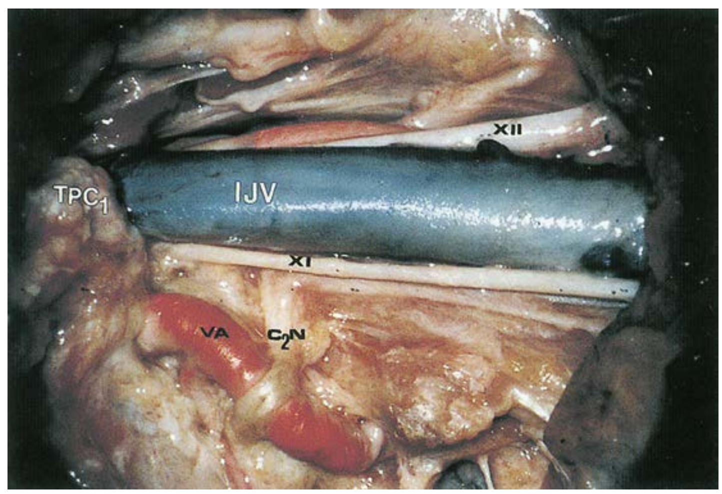

Fig. 9.5

C_2N	C2 nerve	VA	vertebral artery
IJV	internal jugular vein	XI	spinal accessory nerve
TPC_1	transverse process of the atlas	XII	hypoglossal nerve

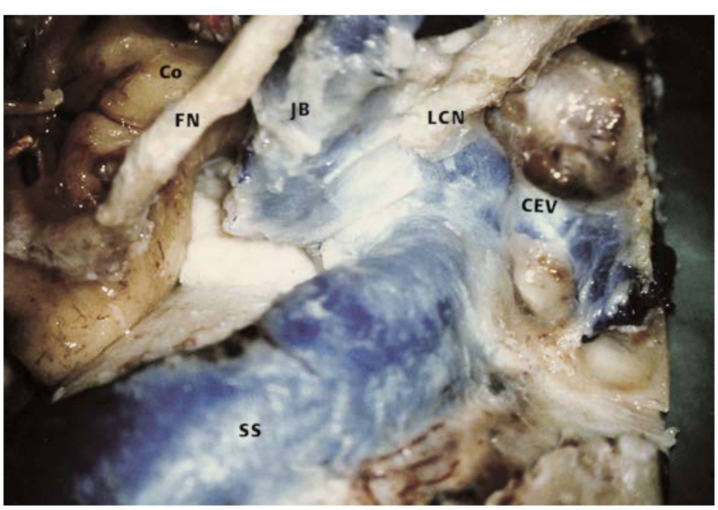

Fig. 9.6

CEV	condylar emissary vein	JB	jugular bulb
Co	cochlea	LCN	lower cranial nerves
FN	facial nerve	SS	sigmoid sinus

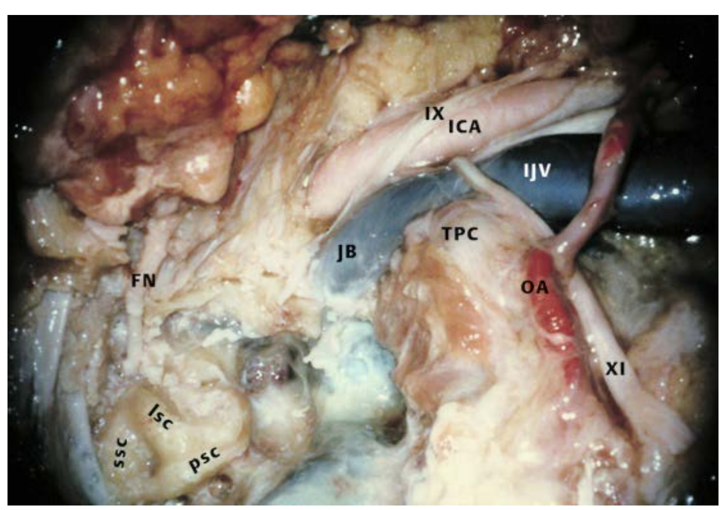

Fig. 9.7

FN	facial nerve	psc	posterior semicircular canal
ICA	internal carotid artery	ssc	superior semicircular canal
IJV	internal jugular vein	TPC	transverse process of the atlas (C1)
JB	jugular bulb		
lsc	lateral semicircular canal	IX	glossopharyngeal nerve
OA	occipital artery	XI	spinal accessory nerve

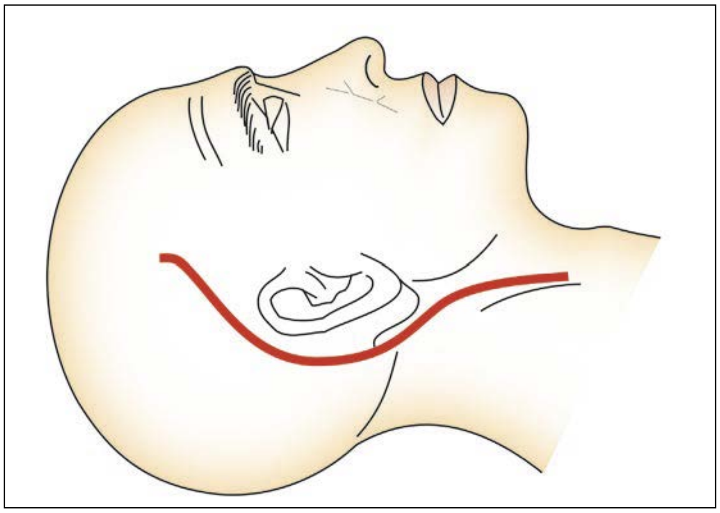

Fig. 9.8 Incision for infratemporal fossa approach type A.

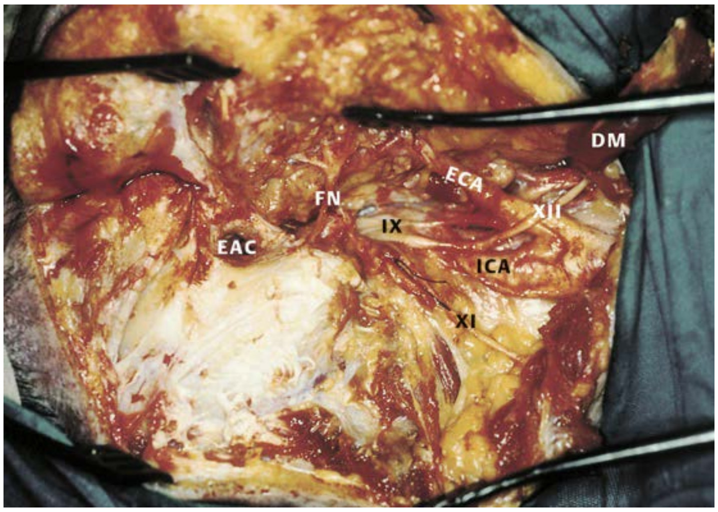

Fig. 9.9

DM	digastric muscle	ICA	internal carotid artery
EAC	external auditory canal	IX	glossopharyngeal nerve
ECA	external carotid artery	XI	spinal accessory nerve
FN	facial nerve	XII	hypoglossal nerve

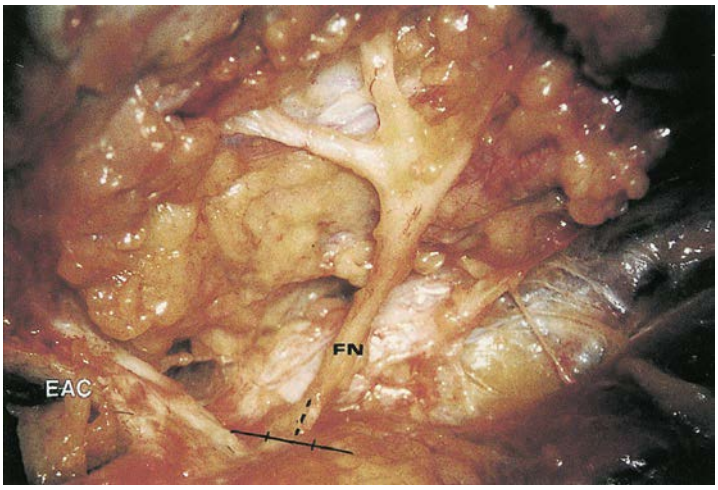

Fig. 9.10

EAC	external auditory canal	FN	facial nerve

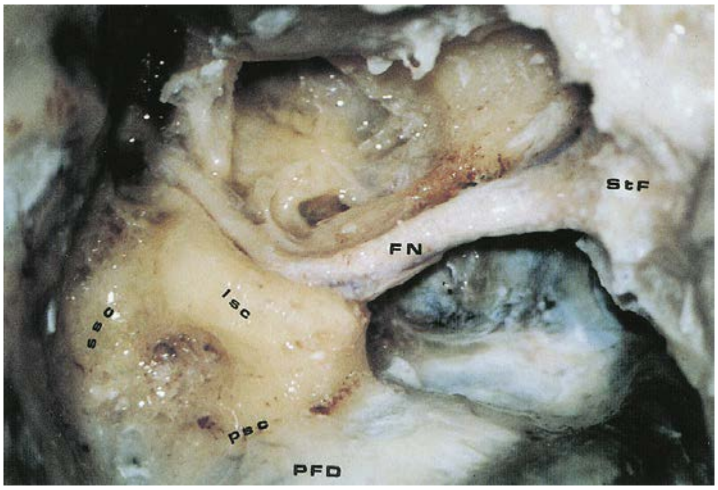

Fig. 9.11

FN	facial nerve	psc	posterior semicircular canal
lsc	lateral semicircular canal	ssc	superior semicircular canal
PFD	posterior fossa dura	StF	stylomastoid foramen

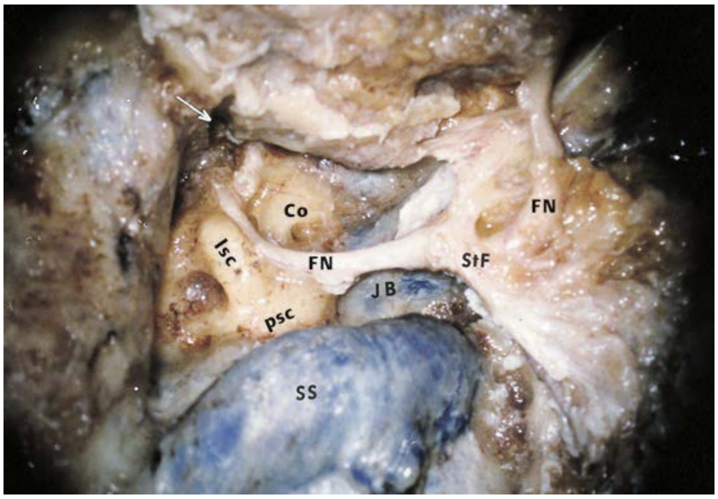

Fig. 9.12

Co	cochlea	PFD	posterior fossa dura
FN	facial nerve	psc	posterior semicircular canal
JB	jugular bulb	StF	stylomastoid foramen
lsc	lateral semicircular canal	arrow:	new bony canal

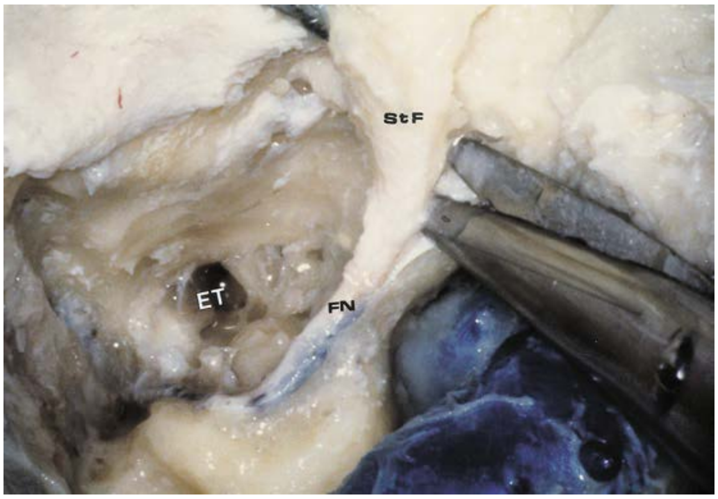

Fig. 9.13

ET	eustachian tube	StF	stylomastoid foramen
FN	facial nerve		

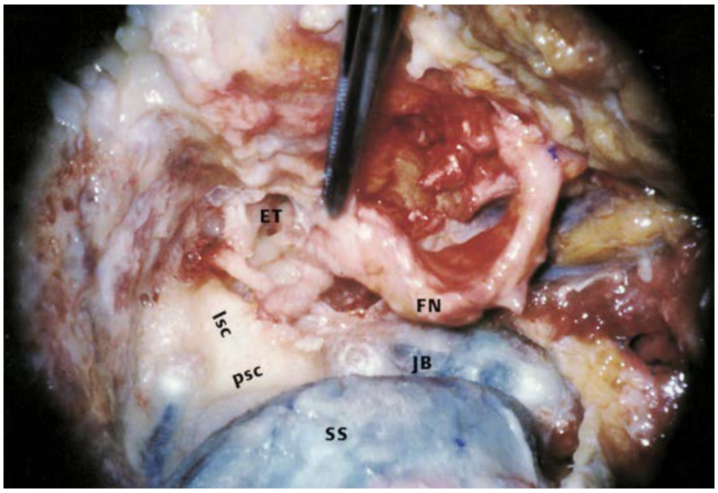

Fig. 9.14

ET	eustachian tube	lsc	lateral semicircular canal
FN	facial nerve	psc	posterior semicircular canal
JB	jugular bulb	SS	sigmoid sinus

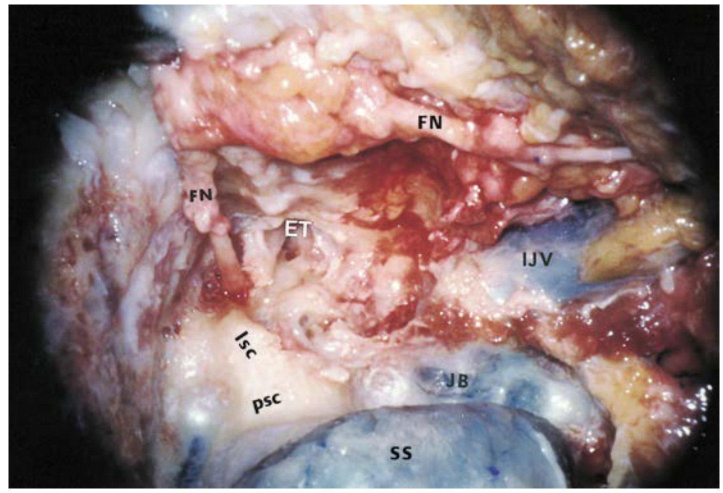

Fig. 9.15

ET	eustachian tube	lsc	lateral semicircular canal
FN	facial nerve	psc	posterior semicircular canal
IJV	internal jugular vein	SS	sigmoid sinus
JB	jugular bulb		

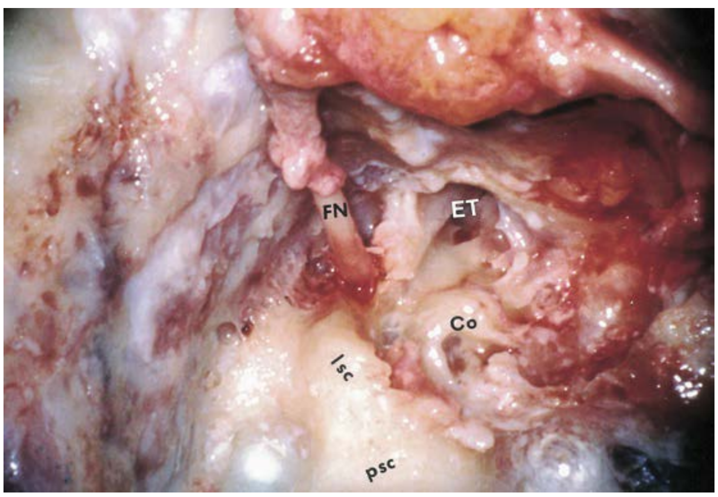

Fig. 9.16

Co	cochlea	lsc	lateral semicircular canal
ET	eustachian tube	psc	posterior semicircular canal
FN	facial nerve		

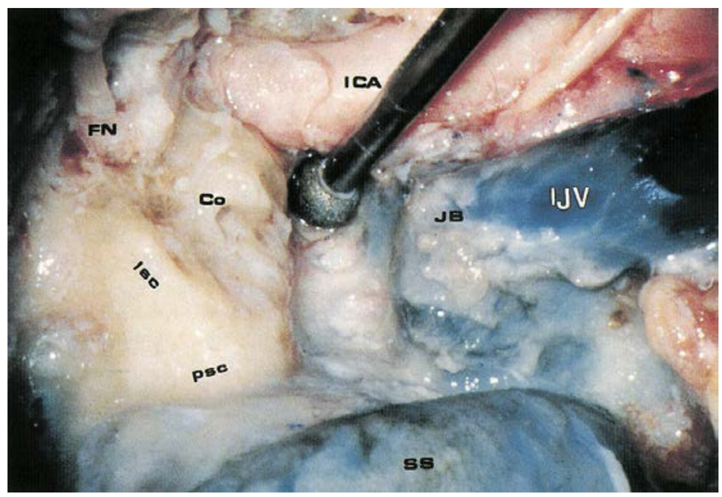

Fig. 9.17

Co	cochlea	JB	jugular bulb
FN	facial nerve	lsc	lateral semicircular canal
ICA	internal carotid artery	psc	posterior semicircular canal
IJV	internal jugular vein	SS	sigmoid sinus

not to injure the facial nerve. The anterior wall of the external auditory canal is further drilled, thus completing the exposure of the vertical portion of the ICA. A small incision is made in the posterior fossa dura just behind the sigmoid sinus, through which an aneurysm needle is passed. Another incision is made just anterior to the sinus to allow for the exit of the needle (**Fig. 9.18**).

14. The sinus is closed by double ligation with a Vicryl suture (**Fig. 9.19**). Suture closure of the sinus, however, may lead to gaps in the dural incision, with a higher risk of cerebrospinal fluid leakage postoperatively. Alternatively, the sigmoid sinus can be closed with extraluminal Surgicel® packing (**Fig. 9.20**).
15. The structures attached to the styloid process are severed. The styloid is fractured using a rongeur, and is then cut with strong scissors (**Figs. 9.21, 9.22**).
16. The remaining tough fibrous tissue surrounding the ICA at its ingress into the skull base is carefully removed using scissors (**Fig. 9.23**).
17. The internal jugular vein in the neck is double ligated and cut or closed with vascular clips (the easier and faster method) (**Fig. 9.24**).
18. The vein is elevated superiorly, with care being taken not to injure the related lower cranial nerves (**Figs. 9.25, 9.26**). In cases in which the eleventh nerve passes laterally, the vein has to be pulled under the nerve carefully to prevent it from being damaged.
19. If necessary the lateral wall of the sigmoid sinus can be removed (**Fig. 9.27**). Removal continues down to the level of the jugular bulb.
20. The lateral wall of the jugular bulb is opened. Bleeding usually occurs from the apertures of the inferior petrosal sinus and the condylar emissary vein. This is controlled with Surgicel® packing (**Fig. 9.28**).
21. If there is limited intradural extension, the dura is opened without injury to the endolymphatic sac (**Fig. 9.29**).
22. **Figures 9.30–9.32** show the view after the dura of the posterior fossa has been opened.

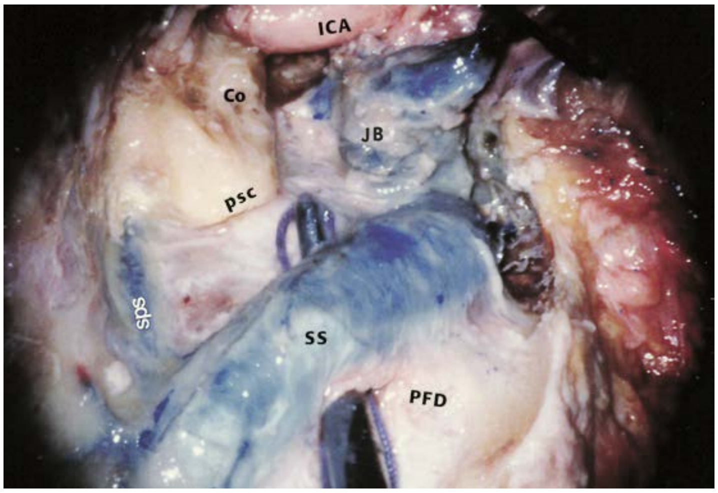

Fig. 9.18

Co cochlea
ICA internal carotid artery
JB jugular bulb
PFD posterior fossa dura
psc posterior semicircular canal
sps superior petrosal sinus
SS sigmoid sinus

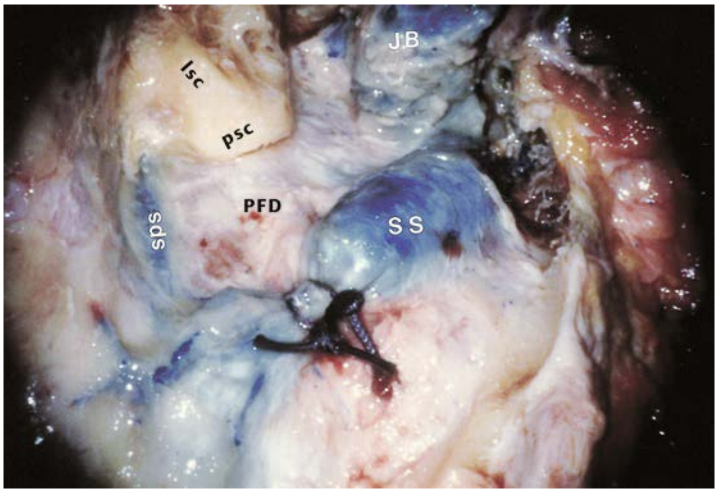

Fig. 9.19

JB jugular bulb
lsc lateral semicircular canal
PFD posterior fossa dura
psc posterior semicircular canal
sps superior petrosal sinus
SS sigmoid sinus

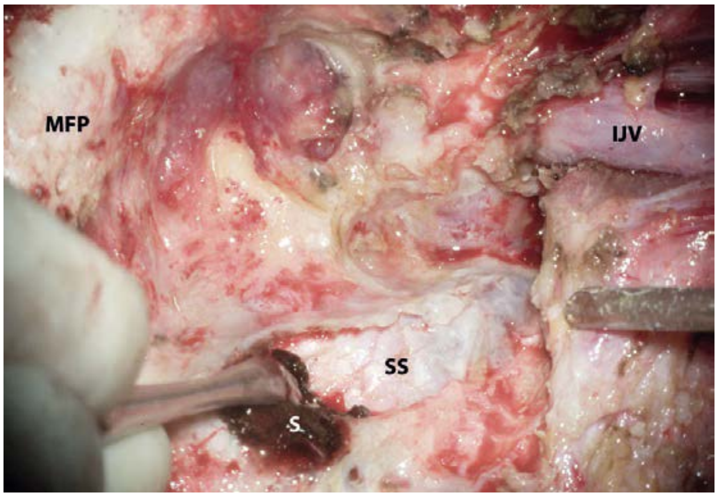

Fig. 9.20 This is the technique of extraluminal closure of the sigmoid sinus to avoid the risk of CSF leakage with suture of the sigmoid sinus.

IJV internal jugular vein
MFD middle fossa plate
S Surgicel
SS sigmoid sinus

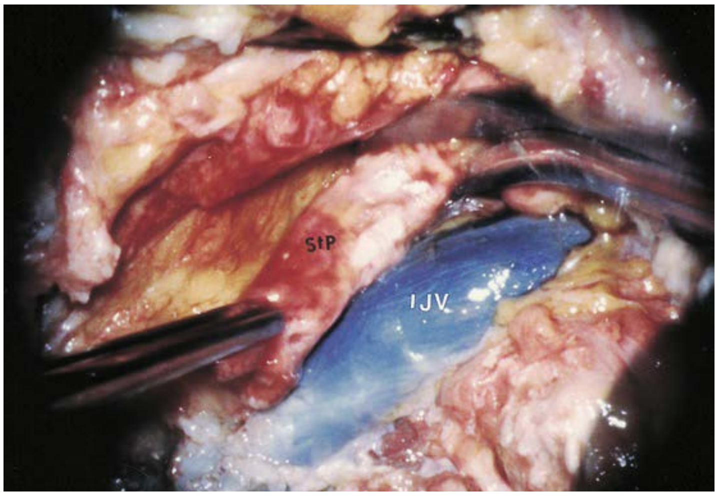

Fig. 9.21

IJV internal jugular vein
StP styloid process

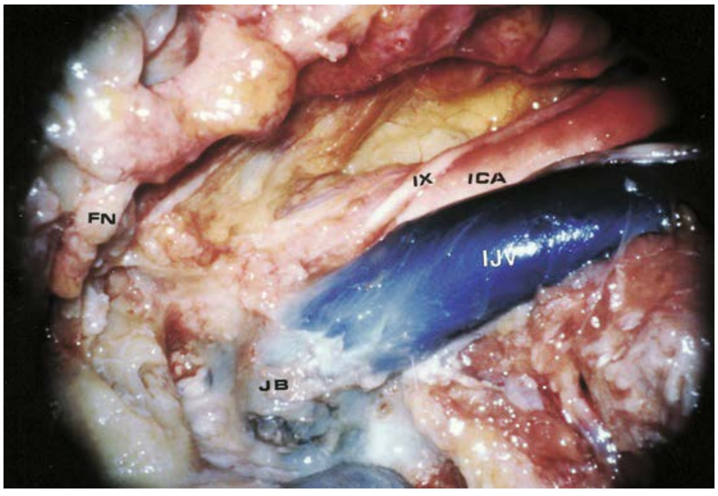

Fig. 9.22

FN facial nerve
ICA internal carotid artery
IJV internal jugular vein
JB jugular bulb
IX glossopharyngeal nerve

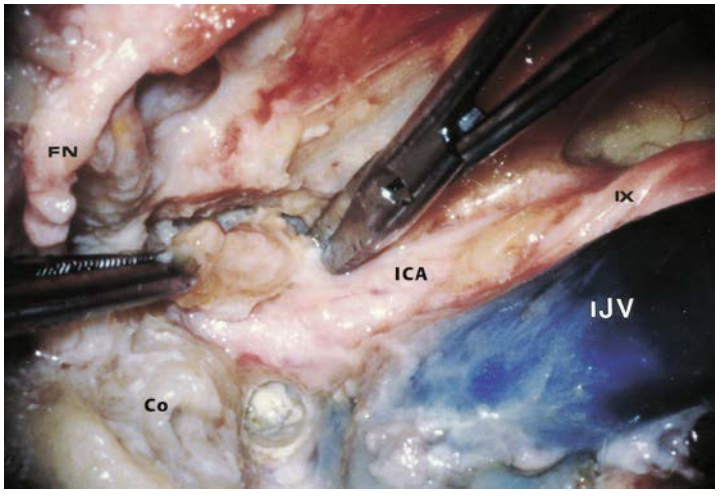

Fig. 9.23

Co cochlea
FN facial nerve
ICA internal carotid artery
IJV internal jugular vein
IX glossopharyngeal nerve

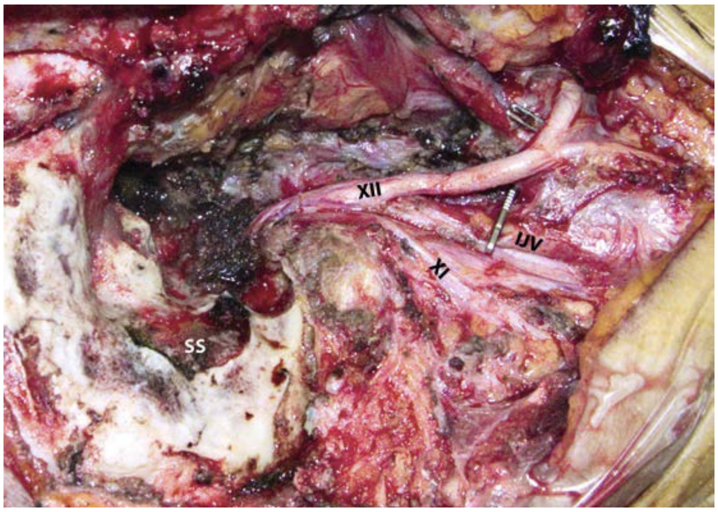

Fig. 9.24

IJV	internal jugular vein	XI	spinal accessory nerve
SS	sigmoid sinus	XII	hypoglossal nerve

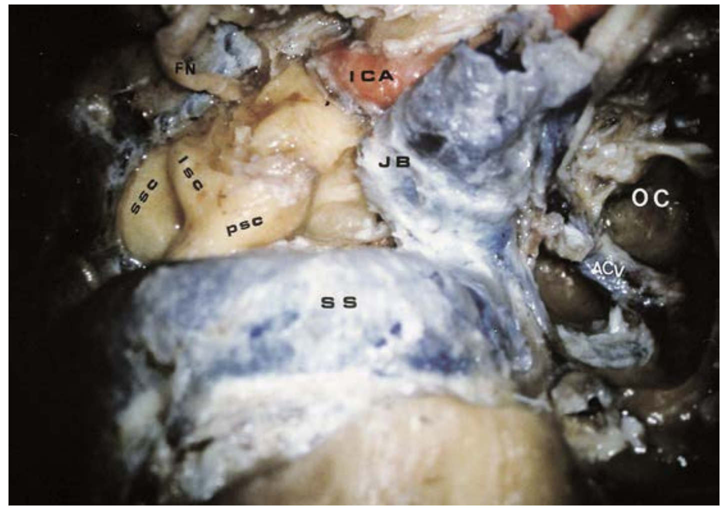

Fig. 9.25

ACV	anterior condylar vein	OC	occipital condyle
FN	facial nerve	psc	posterior semicircular canal
ICA	internal carotid artery	SS	sigmoid sinus
JB	jugular bulb	ssc	superior semicircular canal
lsc	lateral semicircular canal		

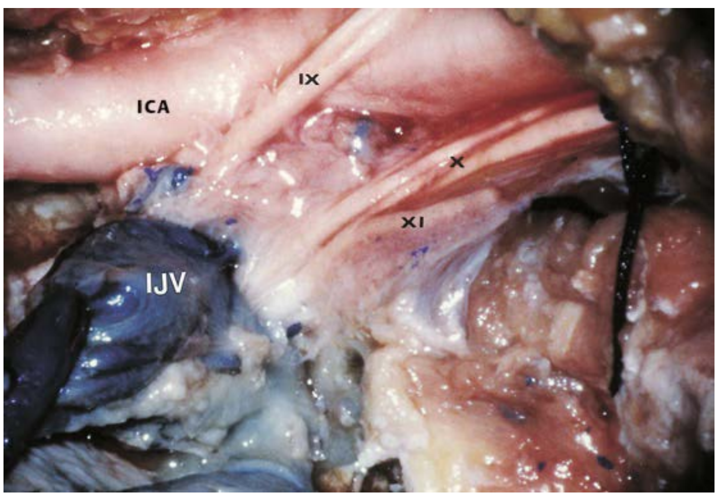

Fig. 9.26

ICA	internal carotid artery	X	vagus nerve
IJV	internal jugular vein	XI	accessory nerve
IX	glossopharyngeal nerve		

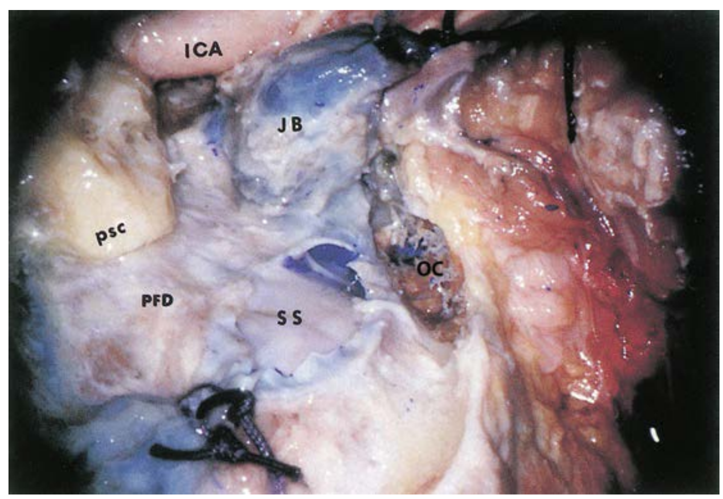

Fig. 9.27

ICA	internal carotid artery	PFD	posterior fossa dura
JB	jugular bulb	psc	posterior semicircular canal
OC	occipital condyle	SS	sigmoid sinus

23. At the end of the procedure, the eustachian tube (**Fig. 9.33**) is closed with a piece of muscle. The dural opening is closed with a muscle plug or with only abdominal fat. We never use a rotated temporalis muscle flap (as suggested by Fisch), so as to avoid aesthetic problems, but the sternocleidomastoid muscle and the digastric muscle are sutured together and the temporalis muscle is left in its place.

Extensions of the Infratemporal Fossa Approach Type A

Based on the ITFA, various extensions are dictated by the extent of the pathology. The standard extension we use is a transcondylar, transtubercular extension for C2–C4 tumors. This allows additional posteroinferior and medial access to the JF, widening the exposure, thus facilitating venous and neural control. The widened angle also affords better access to the petrous apex, medial to the carotid artery. Very rarely a far-lateral approach is employed with full exposure of the vertebral artery. The use of a translabyrinthine extension is occasionally required for otic capsule involvement. A modified transcochlear approach is uncommonly required to access the petrous apex, clival involvement, and infratemporal fossa involvement:

- Transcondylar, transtubercular extension improving posteroinferolateral and medial exposure at the first stage (**Fig. 9.34**)

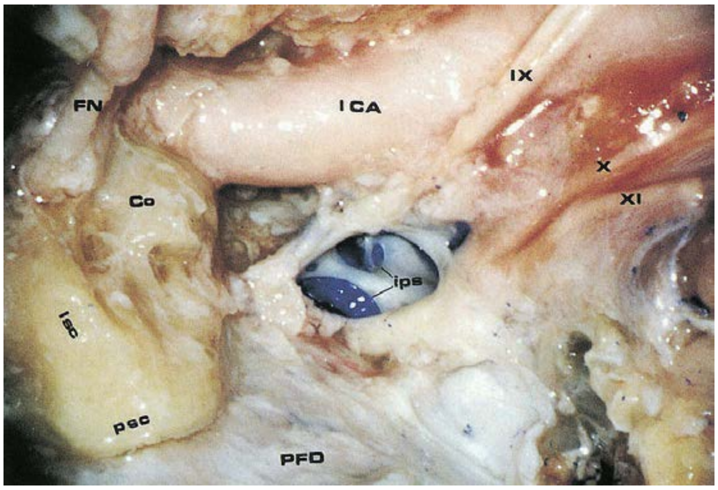

Fig. 9.28

Co cochlea
FN facial nerve
ICA internal carotid artery
ips inferior petrosal sinus
lsc lateral semicircular canal
PFD posterior fossa dura
psc posterior semicircular canal
IX glossopharyngeal nerve
X vagus nerve
XI accessory nerve

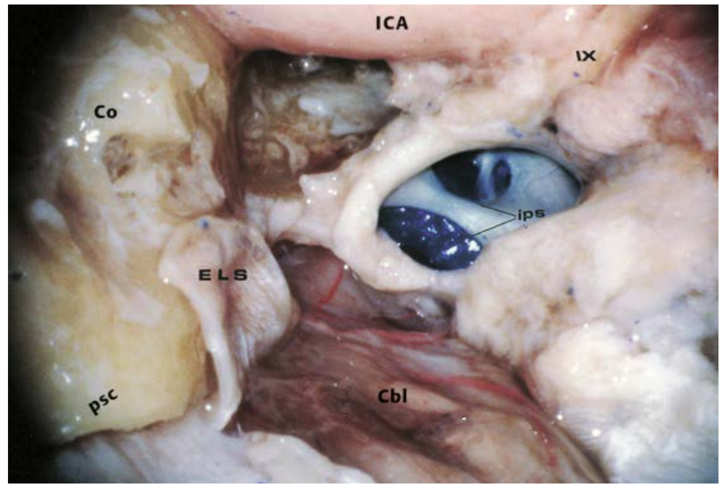

Fig. 9.29

Cbl cerebellum
Co cochlea
ELS endolymphatic sac
ICA internal carotid artery
ips inferior petrosal sinus
psc posterior semicircular canal
IX glossopharyngeal nerve

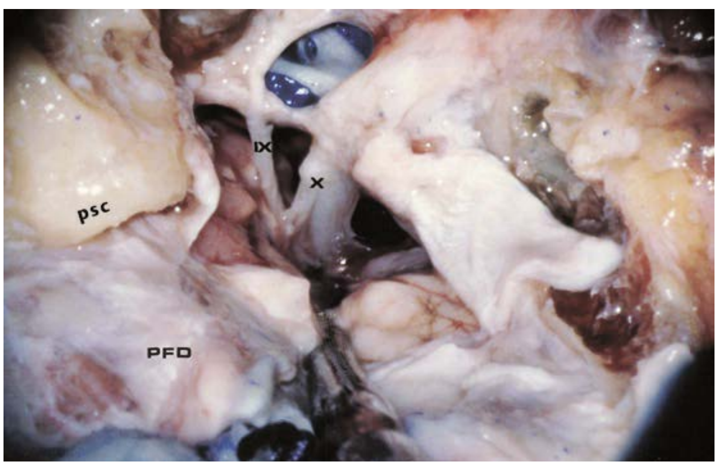

Fig. 9.30 The glossopharyngeal and vagus nerves are well identified in the cerebellomedullary cistern before entering the jugular foramen.

PFD posterior fossa dura
psc posterior semicircular canal
IX glossopharyngeal nerve
X vagus nerve

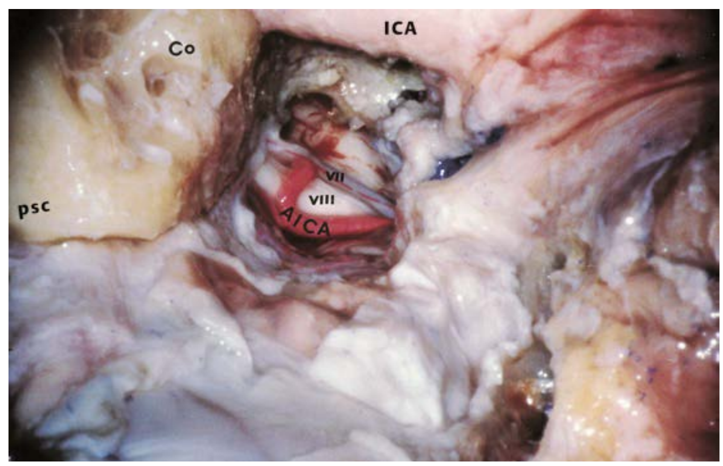

Fig. 9.31 The facial and vestibulocochlear nerves and the anterior inferior cerebellar artery are visible.

AICA anterior inferior cerebellar artery
Co cochlea
ICA internal carotid artery
psc posterior semicircular canal
VII facial nerve
VIII vestibulocochlear nerve

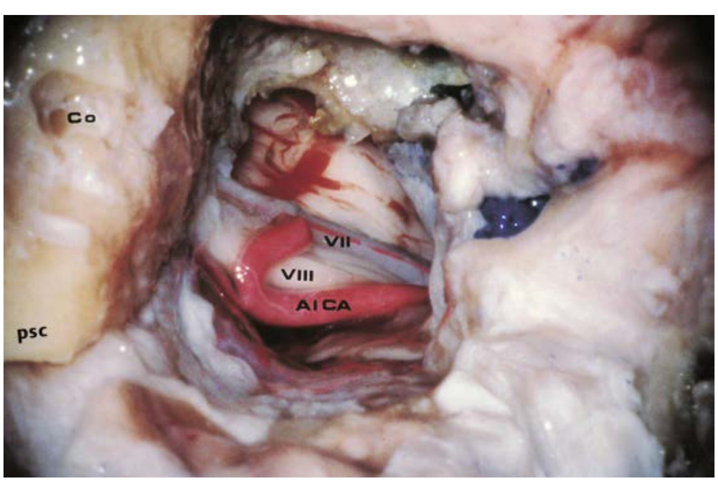

Fig. 9.32 A closer view shows the anterior inferior cerebellar artery passing between the seventh and eighth nerves.

AICA anterior inferior cerebellar artery
Co cochlea
psc posterior semicircular canal
VII facial nerve
VIII vestibulocochlear nerve

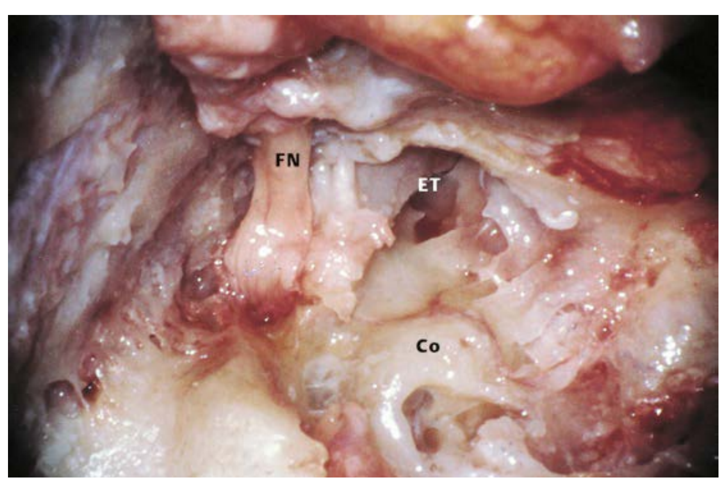

Fig. 9.33 The eustachian tube (ET) and the rerouted facial nerve (FN) are visible.

Co cochlea

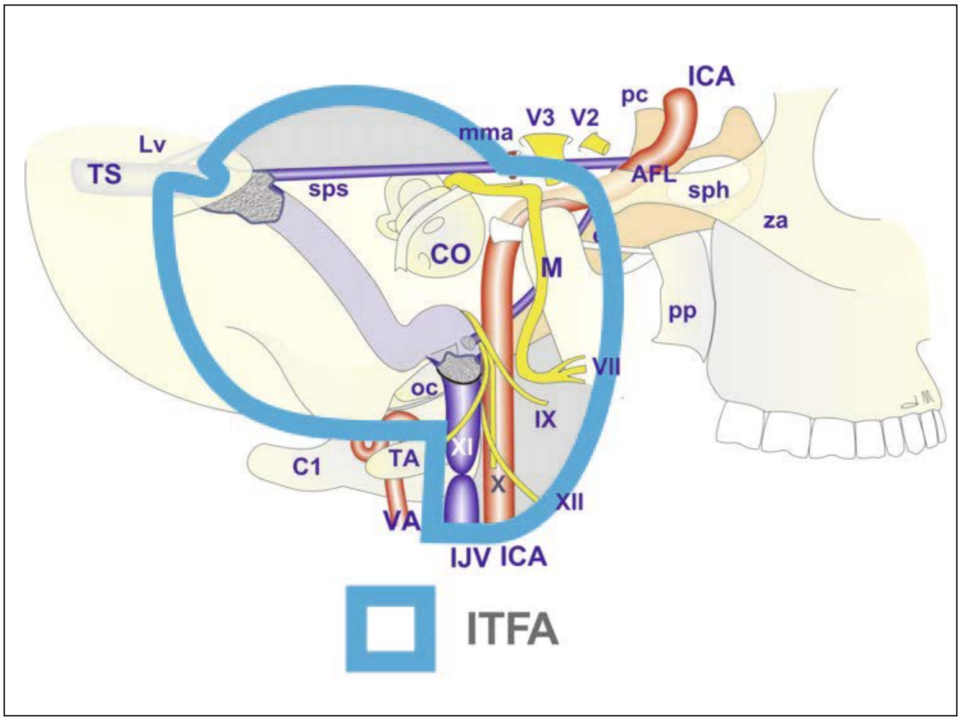

Fig. 9.34 Transcondylar, transtubercular extension improves posteroinferolateral and medial exposure.

AFL anterior foramen lacerum
C1 atlas
CO cochlea
ICA internal carotid artery
IJV internal jugular vein
Lv vein of Labbé
M mandible
mma middle meningeal artery
OC occipital condyle
pc clinoid process
pp pterygoid plate
sph sphenoid sinus
sps superior petrosal sinus
TA transverse process of the atlas
TS transverse sinus
V2 maxillary branch of the trigeminal nerve
V3 mandibular branch of the trigeminal nerve
za zygomatic arch
VA vertebral artery
VII facial nerve
IX glossopharyngeal nerve
XI spinal accessory nerve
XII hypoglossal nerve

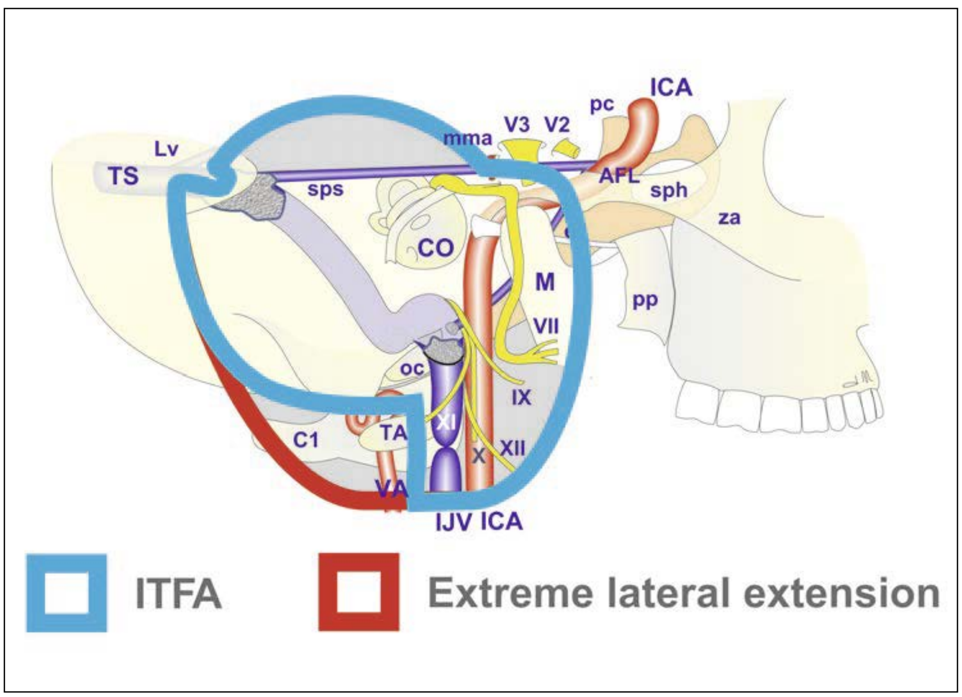

Fig. 9.35 Far-lateral approach further extends posteroinferolateral exposure.

AFL anterior foramen lacerum
C1 atlas
CO cochlea
ICA internal carotid artery
IJV internal jugular vein
Lv vein of Labbé
M mandible
mma middle meningeal artery
OC occipital condyle
pc clinoid process
pp pterygoid plate
sph sphenoid sinus
sps superior petrosal sinus
TA transverse process of the atlas
TS transverse sinus
V2 maxillary branch of the trigeminal nerve
V3 mandibular branch of the trigeminal nerve
za zygomatic arch
VA vertebral artery
VII facial nerve
IX glossopharyngeal nerve
XI spinal accessory nerve
XII hypoglossal nerve

- Translabyrinthine or transotic extension allowing medial and superior exposure at the second stage
- Modified transcochlear extension improving anteromedial exposure at the second stage
- Far-lateral approach further extending posteroinferolateral exposure at the second stage (**Fig. 9.35**) (see Chapter 18).

Transcondylar–Transtubercular Extension

The classic infratemporal fossa approach type A of Fisch permits only superior and anterior exposure of the jugular bulb and is indicated for Class C1 and certain Class C2 tumors. For larger tumor such as Class C2, C3, and C4 tumors involving the lower cranial nerves, a transcondylar–transtubercular extension is required in addition to the classic ITFA. This extension facilitates inferomedial access to the jugular bulb above the lateral mass of the atlas and occipital condyle (**Figs. 9.36–9.38**).
As described in the previous pages, the ITFA for TJP is based on six main surgical steps as follows.

Surgical Steps

First Step (Figs. 9.39.1–9.39.6)

- Retroauricular incision extending to the neck as a cranio-temporo-cervical approach.
- “Cul de sac” closure of the external auditory canal.
- T-shaped musculofascial incision and its posterior reflection.
- Identification and detachment of the sternocleidomastoid muscle and posteroinferior reflection.
- Identification and detachment of the posterior belly of the digastric muscle and anteroinferior reflection.
- Identification of the extratemporal facial nerve.

Second Step (Figs. 9.39.6, 9.39.7)

- Identification and dissection of the internal jugular vein and marking with a umbilical tape.
- Identification and dissection of the common carotid, internal carotid, and external carotid arteries. The common carotid artery is marked with a umbilical tape.
- Identification of the lower cranial nerves.

Third Step (Figs. 9.39.8–9.39.12)

- Removal of the skin of the external auditory canal together with tympanic membrane and ossicles.
- Subtotal petrosectomy with dissection of the middle and posterior fossa dura, dissection of the sigmoid sinus, extraluminal closure of the sigmoid sinus, and removal of the mastoid tip.
- Decompression of the facial nerve and anterior rerouting.
- Identification and removal of the styloid process.

After steps 2 and 3 of the approach, the neck and temporal bone are connected. At this point the transcondylar–transtubercular approach begins and this represents the fourth step.

Fourth Step (Figs. 9.39.13–9.39.19)

- Identification of the splenius capitis muscles.
- Uncovering of the posterior fossa dura toward the occipital skull base to start drilling of the jugular process and occipital condyle.
- Drilling of the jugular process and identification and drilling of the occipital condyle superior to the atlanto-occipital joint posteromedial to the jugular bulb.
- Identification of the hypoglossal canal between the jugular tubercle and occipital condyle above the vertebral artery, if indicated.
- At this point tumor removal begins.

Fifth Step (Figs. 9.39.20–9.39.26)

- Closure of the internal jugular vein with vascular clips.
- Dissection of the jugular vein upward after its mobilization under the spinal accessory nerve.
- Removal of the tumor from the posterior fossa dura.
- Drilling of the infiltrated bone of the fallopian canal and tympanic bone.
- Removal of tumor from the jugular bulb area.
- Drilling of the infiltrated infralabyrinthine cells.
- Opening of the sigmoid sinus for tumor removal.
- Opening of the jugular vein.
- Closure of the inferior petrosal sinus with Surgicel.
- Separation of tumor from the lower cranial nerves.
- Identification of the ICA after extensive drilling of bone and bipolar coagulation of the tumor around the artery.
- Dissection of the tumor from the artery when required.
- Further drilling of all the suspect bone of infralabyrinthine and apical cells until complete removal is accomplished.
- If required, the ICA is partially mobilized and the infiltrated clivus is drilled out.
- The posterior fossa dura is not opened and the intradural portion of the tumor is removed in a second stage.

Sixth Step (Figs. 9.39.27, 9.39.28)

- Meticulous hemostasis.
- Closure of the eustachian tube.
- Closure of any dural tears.
- Obliteration of the cavity with abdominal fat.
- The posterior belly of the digastric muscle is sutured to the sternocleidomastoid muscle.
- Suturing of these two muscles to the temporalis muscle and to the retroauricular soft tissue.
- Watertight closure of the subcutaneous and cutaneous tissue.
- Compression dressing.
- Transposition of the temporalis muscle is never used, to avoid aesthetic problems.
- No drain is used.