2.0 Supraorbital approach

History of the anterior subfrontal and frontolateral approaches

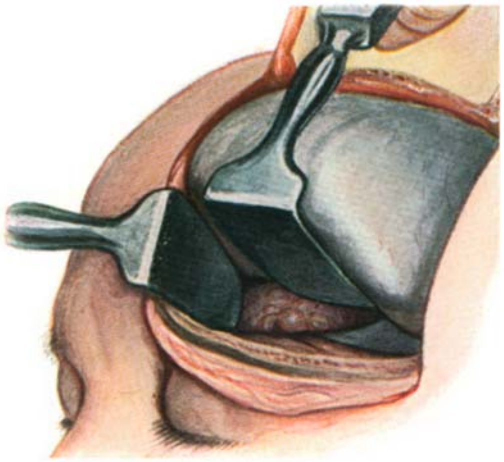


Fig. 2.0.1 *A picture taken from the first edition of FEDOR KRAUSE's pioneering work "Surgery of the Brain and Spine". In this case, KRAUSE approached an extended skull base meningeoma in two steps. After performing the subfrontal craniotomy, the tumor was partially removed in a second session using an extradural exposure, thus minimizing injury to the cortical surface. Due to the rough retraction of the frontal lobe which was necessary because of a severe brain swelling, the patient did not survive.*

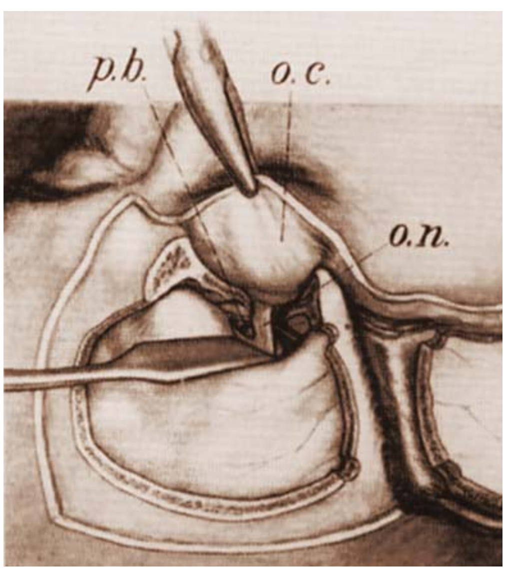


Fig. 2.0.2 *The extradural subfrontal approach of FRAZIER, published in 1913. Craniotomy included removal of the orbital rim and orbital roof, allowing minimal retraction of the frontal lobe.*

A sub- and transfrontal approach was first described by FRANCESCO DURANTE for resection of an olfactory groove meningeoma [DURANTE 1885]. In this first historical description of a planned neurosurgical procedure, Durante reported in his own words that *"for the frontal exploration an osteocutaneous flap was formed, in its shape it resembled a horseshoe, the fronto-temporal bone formed the base of the flap"*. Using this osteoplastic technique, the postoperative course was uneventful and the patient showed no neurological deficits after subtotal resection of the tumor.

The first supraorbital, subfrontal exposure was reported by FEDOR KRAUSE in the first volume of his pioneering work "Surgery of the Brain and Spine" [KRAUSE 1908]. According to the contemporary surgical technique, KRAUSE also created a combined skin, periosteum, and bone flap to reduce intraoperative blood loss and avoid postoperative wound infection (Fig.2.0.1). Although the craniotomy was large, KRAUSE used an extradural route; the frontal, parietal and temporal cortex was not exposed directly as the dura was opened at the sphenoid ridge.

A similar extradural exposure was also described by CHARLES H. FRAZIER to approach the pituitary gland and its neighboring region [FRAZIER 1913]. To minimize severe postoperative complications due to the excessive retraction of the frontal lobe, the author removed the supraorbital arch and the orbital roof using an osteoplastic procedure (Fig.2.0.2).

Other transcranial frontal approaches have required the partial exposure of the anterior half of the cerebral hemisphere as demonstrated in CUSHING's, HEUER's and DANDY's historical descriptions of surgery of the suprasellar region. HARVEY CUSHING performed the first complete removal of a tuberculum sellae meningeoma via subfrontal exposure in 1916 and reported his experience of the resection of 28 tumors in his classical publication, co-authored by LOUISE EISENHARDT [CUSHING & EISENHARDT 1938]. GEORGE J. HEUER described his subfrontal-frontotemporal approach to chiasmal lesions, a prototype of the later frontolateral-pterional craniotomy [Heuer 1920]. Walter E. Dandy published the results of his first eight cases of frontobasal meningeoma in 1922, using Heuer's frontotemporal approach [Dandy 1922]. The authors exposed a large cortical surface which was permanently contaminated with air during surgery causing cortical microinjuries with the subsequent possibility of postoperative epileptic seizures (Figs. 1.0.1, 2.0.3). As previously described, these extended openings were necessary for several reasons; however, the development of diagnostic imaging and surgical techniques allowed a stepwise reduction in the size of the skin incision and craniotomy. Dandy's personal learning process in reducing operative traumatization was well demonstrated in his publication of his so-called hypophyseal approach exposing an ICA aneurysm [Dandy 1938] (Fig. 1.0.2).

An unusual indication for the frontotemporal-hypophyseal approach was the occlusive hydrocephalus [Dandy 1922]. After subfrontal exposure of the suprasellar region, Dandy opened the lamina terminalis achieving an anterior ventriculocisternostomy of the third ventricle. Note that this initial technique to third ventriculostomy involved the sectioning of one optic nerve to expose the tuber cinereum. This method was refined by Byron Stookey and Ted Scarff by puncturing the lamina terminalis and then the floor of the third ventricle (Fig. 2.0.4). In 1963, Scarff published the results of 527 hydrocephalic patients in whom the postoperative mortality was 15% with an initial success rate of 70% [Stookey 1936, Scarff 1951, 1963].

Concerning preoperative planning, many surgeons operated on the nondominant side; however, James L. Poppen suggested that right-handed surgeons should use the right frontal approach and left-handed surgeons the left frontal approach [Poppen 1960]. Note that 22 years after Dandy's description, Poppen's exposure did not respect the hairline (Fig. 2.0.5).

In the early 1970s, an enormous development in technical standards allowed neurosurgeons to use refined approaches. Heuer's and Dandy's fronto-temporal approach was refined by M. Gazi Yasargil [Yasargil 1975] (Fig. 2.0.6). A limited frontolateral approach to aneurysms of the anterior circulation was performed by Mario Brock and Dietz [Brock & Dietz 1978]. The authors summarized the advantages of the small craniotomy as 1) the temporal muscle remains intact because of minimal mobilization; 2) the craniotomy

Fig. 2.0.3 *Heuer's frontotemporal craniotomy exposing the supra- and parasellar region. Note that only the anterior part of the exploration was used approaching the right optic nerve. Therefore, the extensive craniotomy and dural opening caused in this case an unnecessary trauma to the cortical surface.*

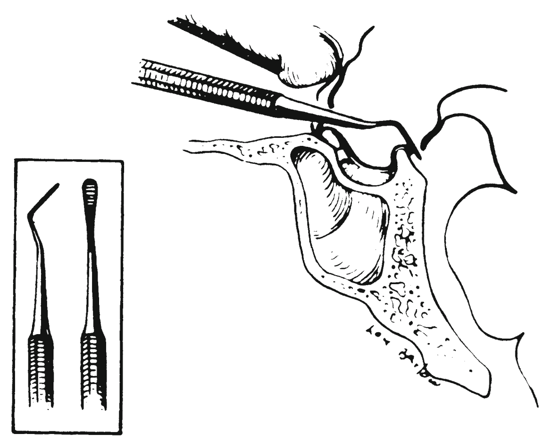


Fig. 2.0.4 *Third ventriculostomy by the subfrontal route, described by Scarff in 1951. Note the puncture of both the lamina terminalis and the floor of the third ventricle, allowing free CSF circulation.*

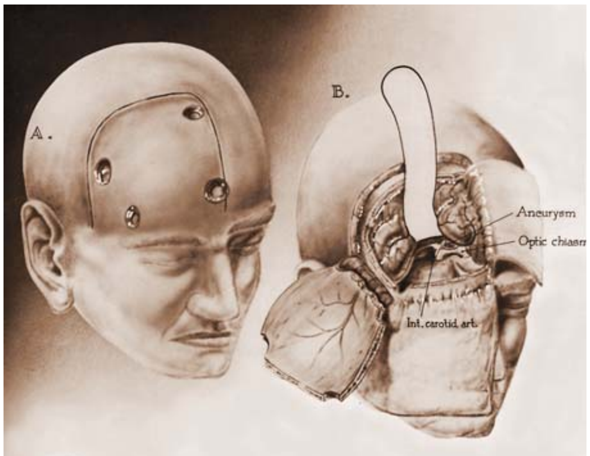


Fig. 2.0.5 *An unilateral subfrontal approach to aneurysms of the anterior communicating artery published by Poppen in 1960. Note that 22 years after Dandy's description, Poppen's skin incision was not concealed behind the hairline giving an unacceptable cosmetic result.*

Fig. 2.0.6 *A refinement of Dandy's hypophyseal approach using microsurgical techniques was published by Yasargil in 1975. This frontotemporal pterional approach is currently the most frequently used for surgical access to sellar and parasellar lesions.*

Fig. 2.0.7 *The limited frontolateral approach to aneurysms of the anterior circulation was published by Brock and Dietz in 1978.*

is exclusively osteoplastic; 3) opening the Sylvian fissure is unnecessary, avoiding injury of the Sylvian vessels. Special attention should be given to this pioneering description of a less invasive subfrontal approach which has provided *"the advantage of permitting an easy, direct and protective attack to such aneurysms through a small and merely osteoplastic craniotomy"* (Fig.2.0.7).

In 1982, James A. Jane reported a different subfrontal-supraorbital exposure to aneurysms and other lesions of the suprasellar area as well as to orbital lesions [Jane 1982]. This approach was modified by Johnny Delashaw by fracturing the orbital roof or including a temporal extension of the craniotomy [Delashaw 1992]. The inferior extension of the supraorbital craniotomy by removal of the orbital rim was also described by Roberto Delfini using an alternative technique with two bone flaps [Delfini 1992]. Ossama Al-Mefty published his experience concerning a supraorbital-pterional approach to skull base lesions by incorporating the superior and lateral orbital walls; Joseph M. Zabramsky described extended temporal and orbitozygomatic bone removal providing wide access to the anterior and middle cranial fossa [Al-Mefty 1990, Zabramsky 1998].

Most variations of these supraorbital and subfrontal approaches resulted in extensive soft tissue and bony exposure, extended dural opening and subsequently necessary brain retraction, causing a possible increase in surgical morbidity unrelated to the lesion itself. However, similar to the small frontolateral approach of Brock and Dietz, recent publications on subfrontal exposures have described limited traumatization of the extra- and intracranial structures. In 1998, Eric van Lindert reported the surgical experience using supraorbital subfrontal craniotomy for the treatment of 197 intracranial aneurysms; Sándor Czirják published his experience in 2001 and 2002 and Ramos-Zúniga presented the trans-supraorbital approach in 2002 [van Lindert 1998, Czirják 2001, 2002, Ramos-Zúniga 2002]. Hans Jakob Steiger described a small orbitocranial approach through a frontotemporal hairline incision to access aneurysms of the anterior communicating artery [Steiger 2001]. In 2002 and 2005, the Mainz technique of performing supraorbital craniotomy through an eyebrow skin incision was described [Reisch 2002, 2005].

During the last decades, many different subfrontal and frontolateral approaches to the suprasellar area have been described, even if some of these exposures were in fact quite similar. However, in his pioneering description, Fedor Krause had already grasped the essence of the subfrontal supraorbital exposure: the suprasellar anatomical structures are free for surgical dissection from an anterior direction, while the anterior part of the temporal lobe does not obscure access to the deep-seated areas.

In the following, this important anatomical fact will be discussed in detail.

General anatomical construction of the anterior cranial fossa and the suprasellar region

According to Krause's concept, to better understand the geometrical and topographical architecture of the anterior cranial fossa, the general anatomical construction and the essential anatomical characteristics of this area must first be discussed. The base of the suprasellar area with the quadrangle of the clinoid processes is on the same level as the anterior skull base. However, lateral to the sellar structures, the base of the middle cranial fossa is situated deeper than the plane of the anterior cranial fossa. According to Johannes Lang, this difference is on average 18 mm on the left and 20 mm on the right side [Lang 1981]. This means the temporal lobe overlaps the suprasellar region from a lateral direction thus necessitating extensive retraction of the temporal lobe when approaching from a lateral temporal direction (Fig. 2.0.8 A). In addition, the temporal pole has an extension anterior to the frontal part of the suprasellar area. Thus, when approaching this area from a frontotemporal pterional direction, the anterior part of the temporal lobe obscures the surgical access: splitting of the Sylvian fissure with manipulation of the temporal veins must also be performed (Fig. 2.0.8 B). However, using the anterior subfrontal approach, access to the suprasellar area is free for surgical dissection and retraction of the temporal lobe is unnecessary. In addition, the subfrontal approach allows early access to the suprasellar area without opening the Sylvian fissure (Fig. 2.0.8 C).

The main target region using a subfrontal approach is the suprasellar area with all its surrounding structures. To work within this region in a three-dimensional manner, it is best explained in a geometric way as a virtual pyramid (Fig. 2.0.9). The base of the pyramid is formed by the diaphragma sellae at the level of the frontal

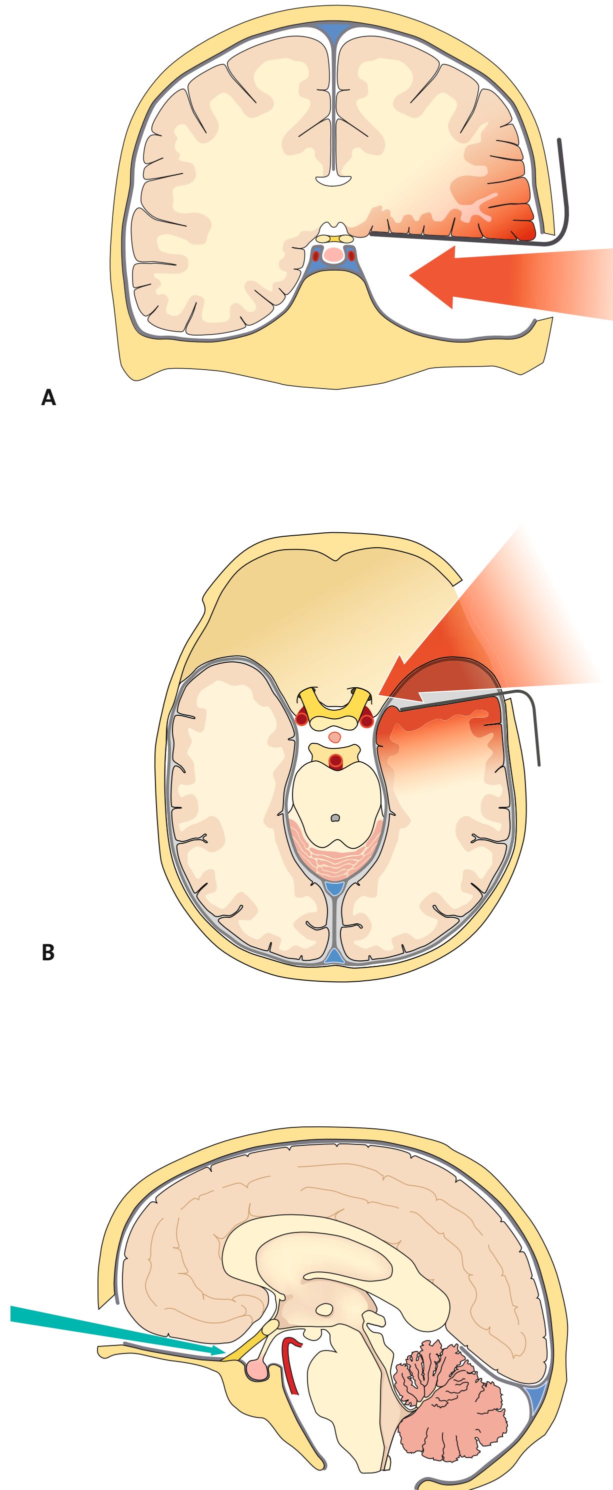
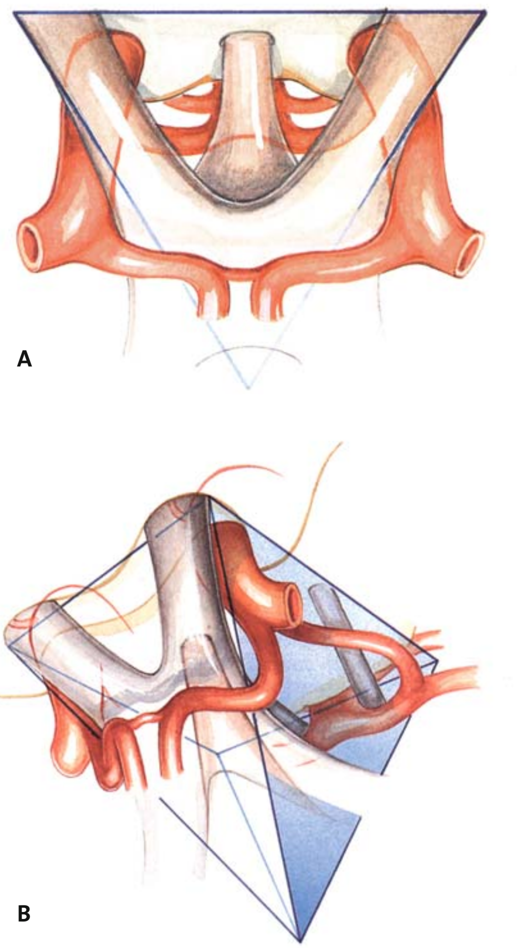


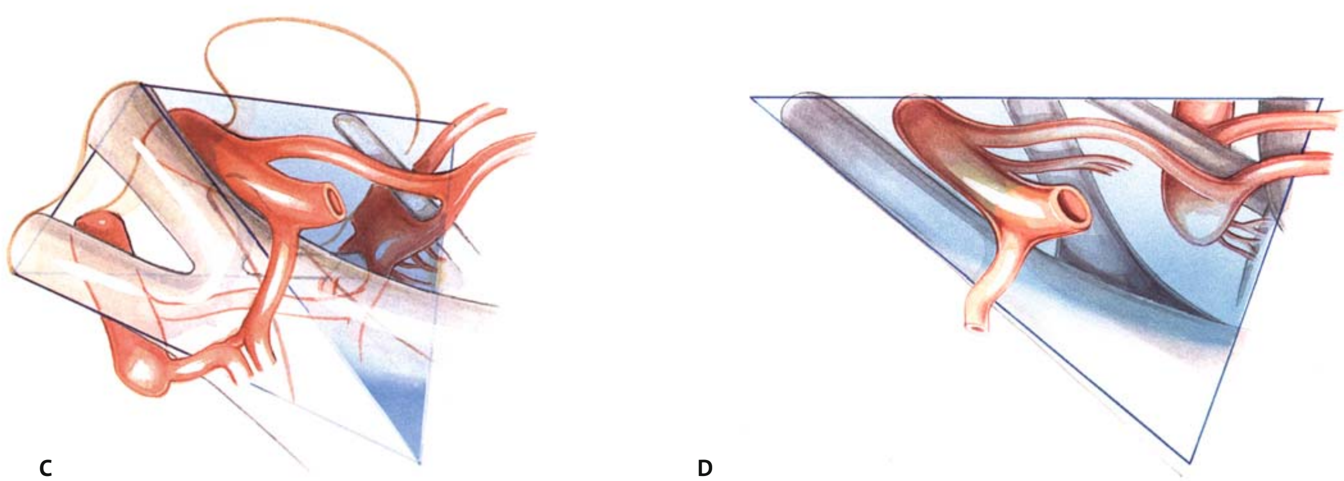
Fig. 2.0.8 *Schematic pictures demonstrating the sellar and parasellar region in the coronar, axial and sagittal planes. Note that when observing the suprasellar area from the lateral subtemporal or frontotemporal pterional direction, the temporal lobe obscures the surgical access (red arrows). Using the anterior subfrontal approach, access to the suprasellar area is free for surgical exploration (green arrow).*

skull base. Each of the triangular planes of the pyramid is defined by certain structures. The anterior plane of the pyramid is formed almost completely by the optic nerves, chiasm and the lamina terminalis. The first segments of both ACA and the ACoA are also in direct relationship to this plane. The side of the pyramid includes the CN II and optic tract, the CN III, the ICA and its two supraclinoid branches, the posterior communicating and anterior choroidal arteries. The posterior pyramidal plane is defined by the ventral surface of the brain stem and BA with the posterior cerebral and superior cerebellar arteries. The axis of the pyramid is formed by the infundibulum and pituitary stalk. This virtual construction enables perception of the various viewing angles into this space; the pyramid and the different windows between its structures can be well approached using different optimal angles. In addition, it also helps to understand how anatomical structures are displaced in the case of a space-occupying lesion within the suprasellar area (Fig. 2.0.9).



A

B



C

D

Fig. 2.0.9 *Artist's drawing demonstrating the suprasellar area as a virtual pyramid from different viewing angles. Note that the same anatomical structures are visualized very differently according to diverse surgical exposures: A) median subfrontal exposure; B) frontolateral supraorbital exposure; C) frontotemporal pterional exposure; D) subtemporal exposure. This virtual construction also helps to understand how anatomical structures are displaced in the case of space-occupying lesions within the suprasellar region.*

Ipsilateral	Midline	Contralateral
Orbital roof Anterior clinoid process, APcL Posterior clinoid process Roof and lateral wall of the CS Basal frontal lobe Gyrus rectus Sylvian fissure Anteromedial temporal lobe Uncus hippocampi CN I, CN II, CN III, CN IV ICA, OphtA, PCoA, AChA, incl. perforators A1, A2, M1, M2, incl. perforators P1, P2, SCA, incl. perforators Superficial temporal vein	Crista Galli Olfactory groove Planum sphenoidale Tuberculum sellae Lamina terminalis Anterior third ventricle Pituitary stalk Interpeduncular fossa ACoA Distal BA with perforators	Orbital roof Anterior clinoid process Basal frontal lobe Gyrus rectus Sylvian fissure Temporal pole Crus cerebri CN I, CN II, CN III ICA, OphtA, PCoA, AChA, incl. perforators A1, A2, M1, M2, incl. perforators P1, P2, SCA, incl. perforators

Table 2.0.1 *Anatomical structures approached through the supraorbital cranitomy.*

Using the supraorbital craniotomy several anatomical structures of the supra- and parasellar area can be exposed (Table 2.0.1). In the following, the surgical technique of the supraorbital subfrontal approach is described as a step-by-step dissection.

Surgical technique

1. Patient positioning

The patient is placed supine on the operating table. If used, the single pin of the head fixator should be placed in the opposite frontal area to allow free manipulation of the ipsilateral side during the procedure. The pin should not be placed into the temporalis muscle as this diminishes the stability of the system and can cause postoperative temporal hematoma.

Fig. 2.0.10

Step 1

Initially, the head is elevated ca. 15° and the head of the operating table is elevated above the thorax to facilitate venous drainage. Elevation provides decompression of the cervical vessels, larynx and ventilation tube (Fig. 2.0.10).

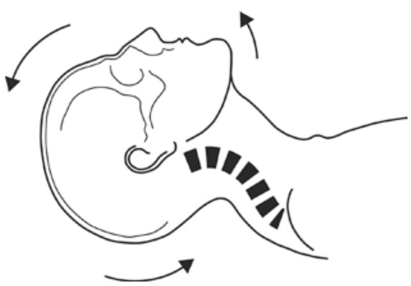


Fig. 2.0.11

Step 2

Retroflexion not only supports gravity-related self-retraction of the frontal lobe but also depends upon the target region and the precise anatomical and pathological situation. Lesions with close proximity to the frontal skull base require a retroflexion of 10°–15°. Structures situated more cranially, such as lesions of the anterior third ventricle can be optimally approached with more head retroflexion of ca. 30° (Fig. 2.0.11).

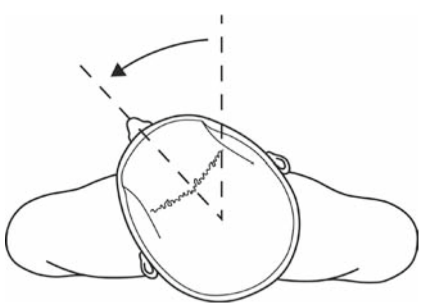


Fig. 2.0.12

Step 3

Thereafter, the head is rotated to the contralateral side, the degree of rotation depending on the target region: for the ipsilateral temporomesial area, Sylvian fissure and the MCA, a rotation of ca. 10° to 15° is sufficient. Approaching the lateral suprasellar and retrosellar area with the CN II, ICA, and BA, a rotation of ca. 30° is necessary. For the anterior suprasellar region with structures of the lamina terminalis and ACoA, a rotation of 30° to 45° and for the olfactory groove, 45° to 60° rotation is required. By choosing the correct angle between 30° and 60°, one can also make contralateral lesions visible. Note that right-handed surgeons using a left-sided craniotomy need more rotation to provide an efficient working position (Fig. 2.0.12).

Fig. 2.0.13

Step 4

As the last positioning step, the head is lateroflected ca. 10° to the contralateral side, allowing an ergonomic working position during surgery (Fig. 2.0.13).

2. Anatomical landmarks and orientation

For the appropriate skin incision, the important anatomical landmarks of the osseous skull, such as the glabella, frontal paranasal sinus, orbital rim, supraorbital foramen, temporal line, frontobasis, impression of the Sylvian fissure and the zygomatic arch are palpated precisely and marked with a sterile pen. Special attention must be given to the course of the superficial neurovascular structures of the frontotemporal region such as the supraorbital nerves and artery, and the frontal branch of the facial nerve (Fig. 2.0.14).

Only thereafter should the borders of the craniotomy be marked, taking into consideration the position of the lesion and the landmarks drawn on the skin. After defining the craniotomy, the individual optimum line of the skin incision is marked with the pen. Usually this skin incision is placed laterally to the supraorbital nerve running within the eyebrow (Fig. 2.0.14). Shaving of the eyebrow is not necessary; for a pleasing cosmetic outcome, the incision line must be placed exactly in the haired area. If the eyebrow is not dominant, the skin incision should be made in a crease or scar of the supraorbital area. Alternatively, an incision behind the hairline is also possible. The eyelids are protected with sensitive tape and the skin and eyebrow disinfected with alcohol solution.

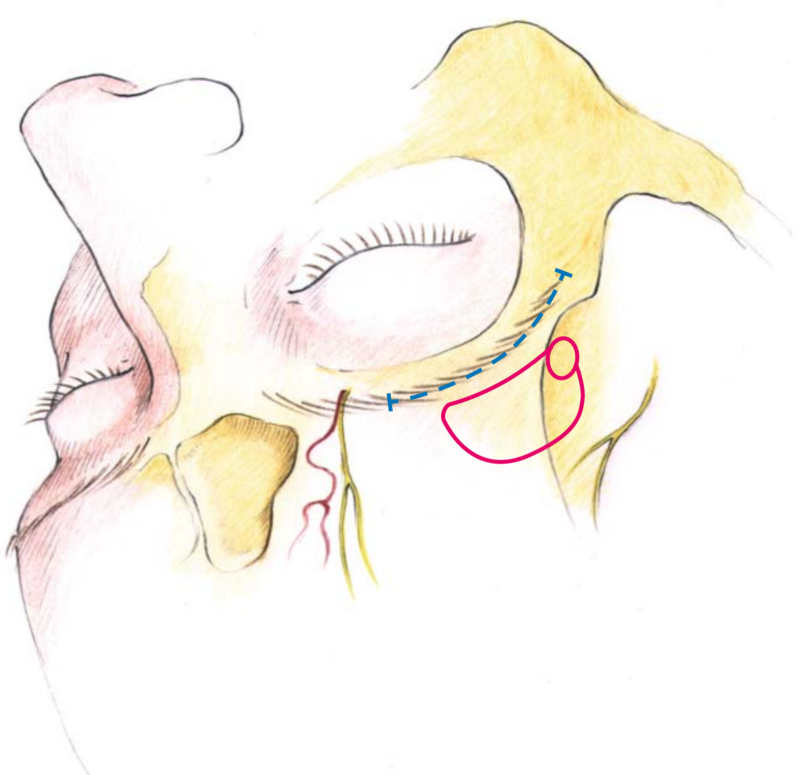


Fig. 2.0.14 *Definition of the craniotomy according to the anatomical landmarks of the frontotemporal region. The skin incision should be made within the eyebrow, giving a pleasing postoperative cosmetic result.*

3. Craniotomy

Step 1

Right side. The skin incision begins laterally from the supraorbital incisura, and is made within the eyebrow, in some cases extending a few millimeters over the lateral projection of the brow into the frontozygomatic area. To achieve a cosmetically optimal result, the incision must follow the orbital rim. Note that the skin incision should not extend medially to the supraorbital nerve so as to avoid frontal numbness. The frontal branch of the facial nerve and the superficial temporal artery never cross this type of skin incision; however, the frontal branch may be temporarily affected postoperatively because of compression due to skin retraction. After skin incision, the subcutaneous tissue should be dissected carefully in a frontal direction (Fig. 2.0.15).

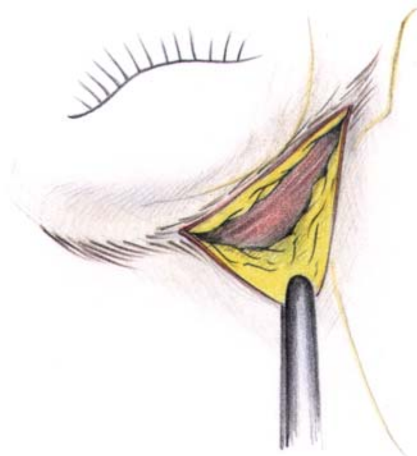


Fig. 2.0.15

Step 2

The skin flap is temporarily retracted with stitches exposing the frontal belly of the occipitofrontal muscle, the orbicularis oculi and the temporal muscles. Note that the skin flap should be gently pushed upward in an orbital direction to avoid periorbital hematoma; however, the flap should be retracted forcefully downwards in a frontal direction to achieve optimal exposure (Fig. 2.0.16).

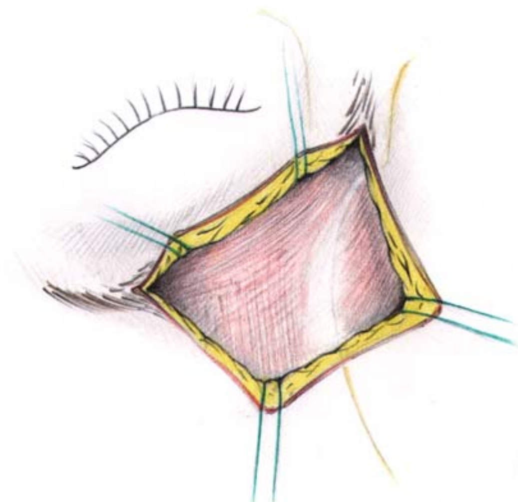


Fig. 2.0.16

Step 3

The frontal muscles are cut with a monopolar electrode knife parallel to the orbital rim and the temporal muscle is stripped from its bony insertion. The temporal muscle is retracted laterally, the frontal muscle upwards with strong sutures (Fig. 2.0.17). Exposure and mobilization of the temporal muscle should be restricted to the necessary minimum to prevent postoperative problems with chewing. Note that the frontal and orbicular muscles should be gently pushed upwards to the orbit. Careful dissec-

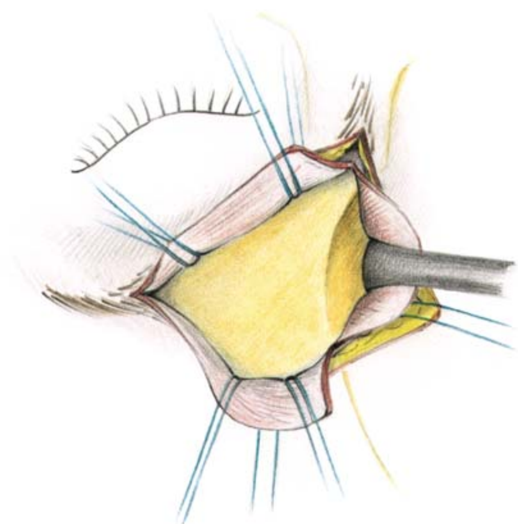


Fig. 2.0.17

Fig. 2.0.18

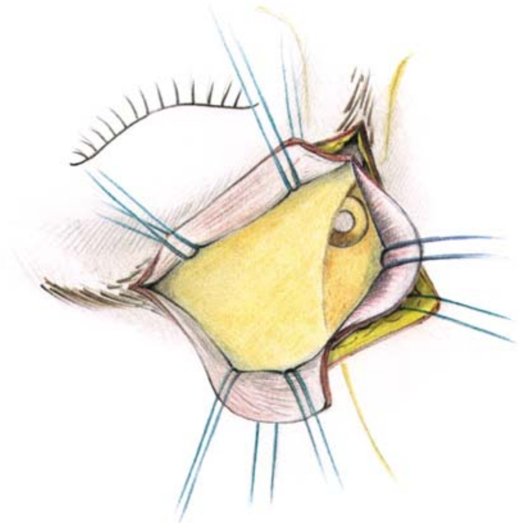


Fig. 2.0.19

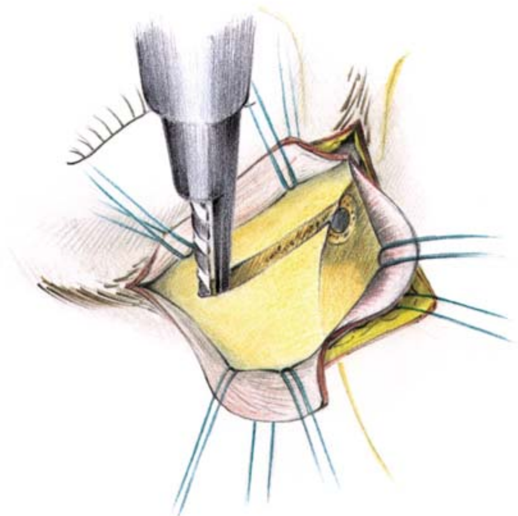
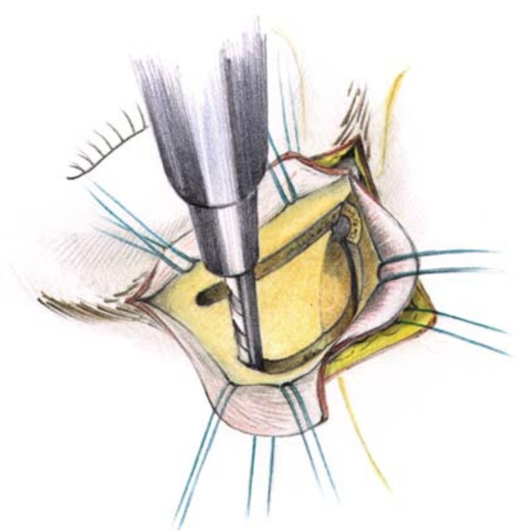


Fig. 2.0.20



tion and minimal retraction of this muscular layer is essential to avoid postoperative periorbital hematoma. Local hemostasis needs to be performed rapidly and with precision.

Step 4

In all cases, an osteoplastic craniotomy is performed. Using a high-speed drill, a single frontobasal burr hole is drilled posterior to the temporal line. Special attention must be given to this burr hole trephination, especially to its relationship to the frontal skull base and to the orbit. Note that after an optimum placement of the burr hole, the drill must be pushed downwards to expose the anterior fossa without penetrating the orbit (Fig. 2.0.18).

Step 5

After minimal enlargement of the hole with fine punches and mobilization of the dura, a straight line is cut with a high-speed craniotome parallel to the orbital rim in a lateral to medial direction, taking into account the lateral border of the frontal paranasal sinus (Fig. 2.0.19).

Step 6

Thereafter a "C" shaped line is cut from the burr hole to the medial border of the previously performed frontobasal line, thus creating a bone flap with a width of ca. 15–20 mm and a frontal extension of ca. 10–15 mm (Fig. 2.0.20). Hemorrhages occurring during the craniotomy can be stemmed by bipolar coagulation and wax.

Step 7

A very important stage of the craniotomy after removal of the bone flap is the high-speed drilling of the inner edge of the bone above the orbital rim under protection of the dura. Careful removal of this inner bone edge can significantly increase the angle for visualization and manipulation. These maneuvers greatly facilitate the use of the operating microscope and microsurgical instruments in the further course of the operation. Small osseous extensions of the superficial orbital roof should also be drilled extradurally to obtain optimal intradural visualization (Fig. 2.0.21).

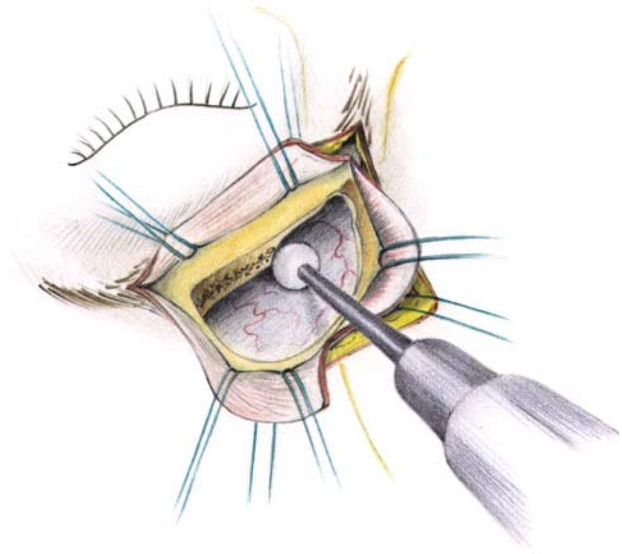


Fig. 2.0.21

Step 8

The dura should be opened in a curved fashion with its base toward to the supraorbital rim (Fig. 2.0.22).

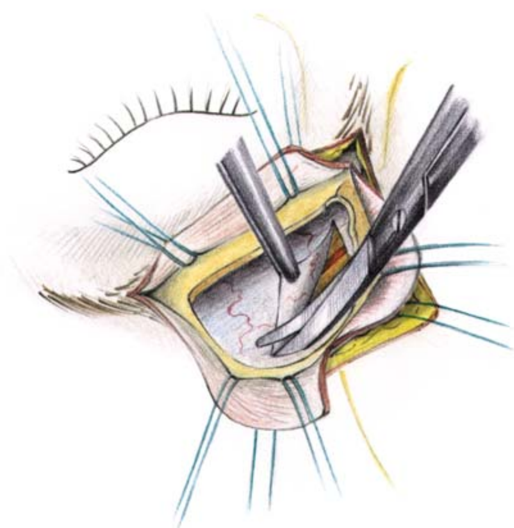


Fig. 2.0.22

Step 9

The free dural flap is fixed upwards with two sutures. Other dural elevation sutures are not required (Fig. 2.0.23).

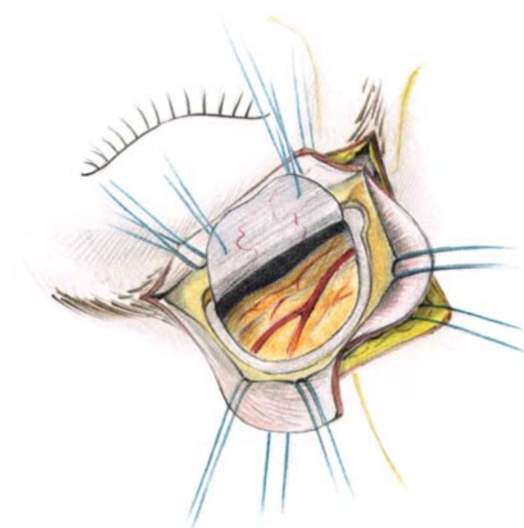


Fig. 2.0.23

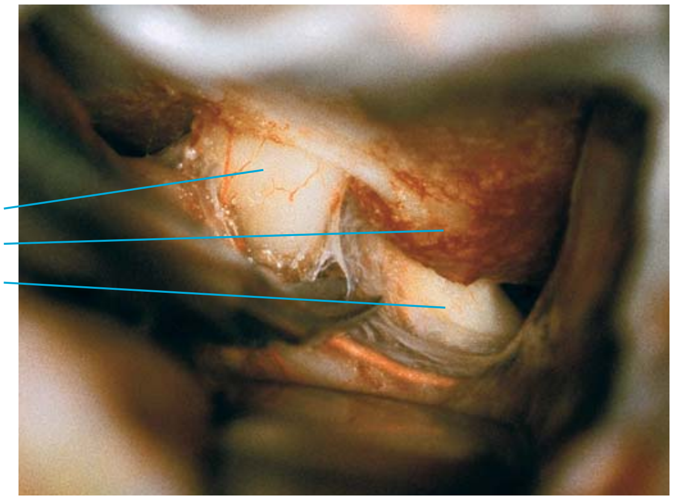


Fig. 2.0.24

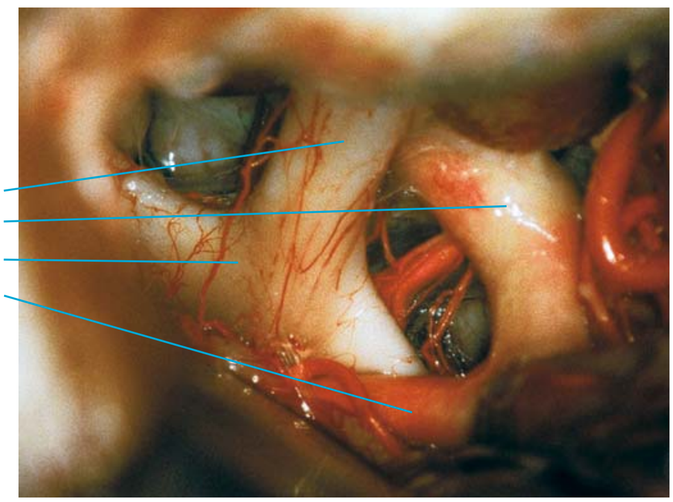


Fig. 2.0.25

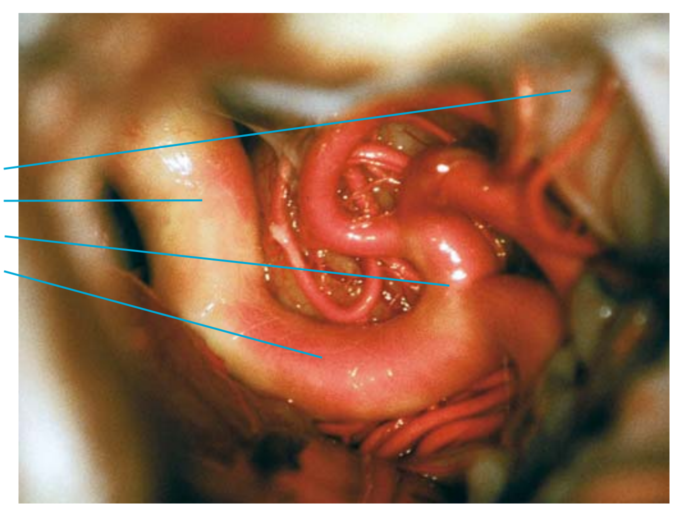


Fig. 2.0.26

4. Intradural dissection

Step 1

Right side. Dissection on fresh human cadaver. Arterial vessels are prepared with red colored latex solution. After opening the dura mater, the first step should be the sufficient drainage of CSF by opening the chiasmatic and carotid cisterns. In the case of high ICP, for example, after massive subarachnoid hemorrhage, the lateral ventricle should be punctured with a ventricular cannula. After removal of the subarachnoidal or ventricular CSF, the frontal lobe deflates spontaneously, rendering significant retraction of the frontal lobe unnecessary. Generally, the self-retaining spatula is left in place as a "brain protector" rather than the brain retractor. Through the subfrontal way the suprasellar region can be immediately approached, without time-consuming and traumatic opening of the Sylvian fissure (Fig. 2.0.24).

Step 2

After dissection of the arachnoid membranes, the anterolateral structures of the suprasellar pyramid are exposed: the ipsilateral CN II, chiasm, and the supraclinoid segment of the ICA and the A1 segment. The frontal lobe is minimally retracted and the INOP and OPCA windows are opened (Fig. 2.0.25).

Step 3

After opening the ipsilateral Sylvian fissure in a medial to lateral direction, the first part of the MCA can be seen. Note that from the subfrontal direction, the M1 segment can be optimally visualized without retraction of the temporal lobe. Splitting of the Sylvian fissure in a medial to lateral direction is time-consuming and less traumatic than the lateral to medial direction, using a frontotemporal pterional craniotomy (Fig. 2.0.26).

Step 4

Dissecting again to the midline, the entire A1 segment can be approached. Note the ACoA and the contralateral A1. The lamina terminalis is also visible. Aneurysms of the ACoA can be well approached via the supraorbital craniotomy, even without removal of the gyrus rectus. Note the Heubner artery on the right side (Fig. 2.0.27).

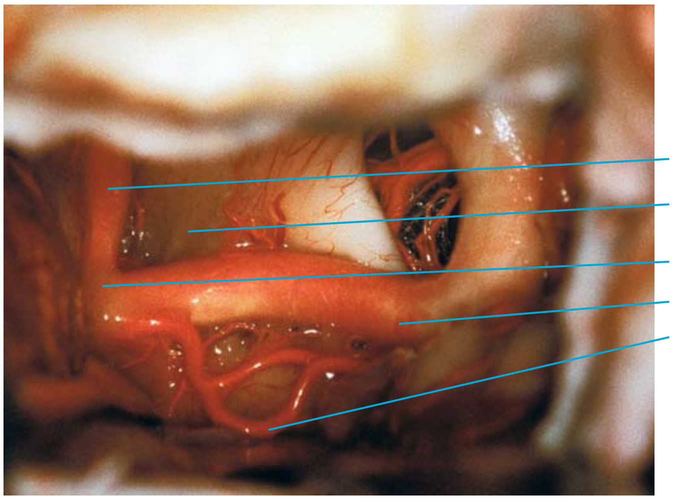


Fig. 2.0.27

Step 5

The dissection is continued in the contralateral direction observing the opposing CN II and ICA. Note the special relationship between the optic nerve and carotid artery and the origin of the OphtA. Medial located aneurysms of the OphtA can be optimally approached through a contralateral subfrontal craniotomy (Fig. 2.0.28).

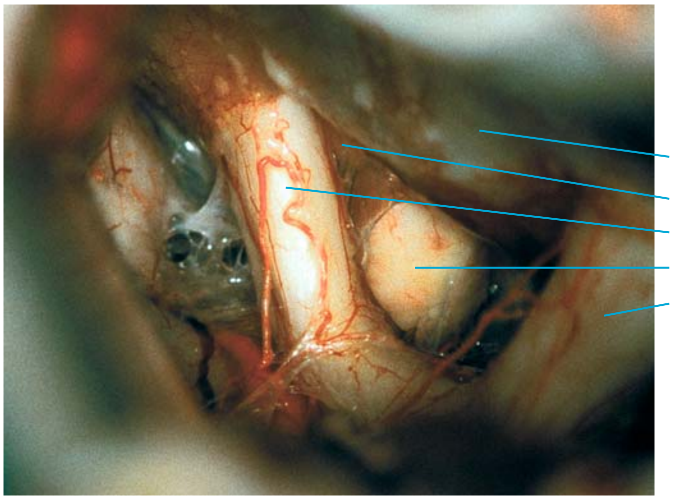


Fig. 2.0.28

Step 6

According to the keyhole concept, the contralateral ICA bifurcation can be also approached through the limited supraorbital craniotomy. The carotid cistern and the Sylvian fissure are opened; note the temporal lobe and the A1 and M1 segments of the opposite side (Fig. 2.0.29).

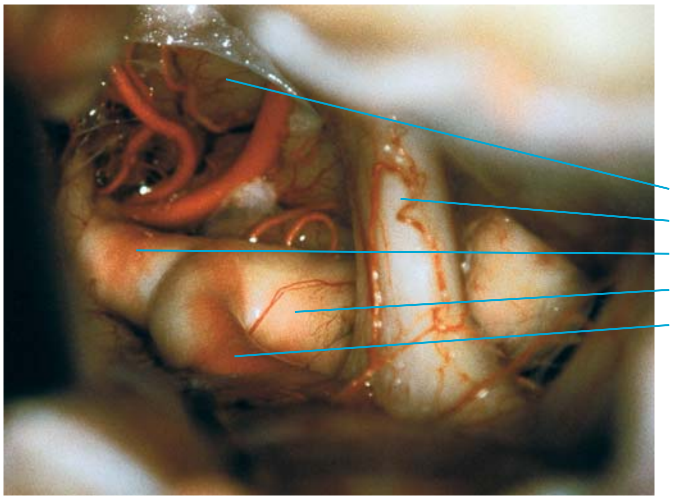


Fig. 2.0.29

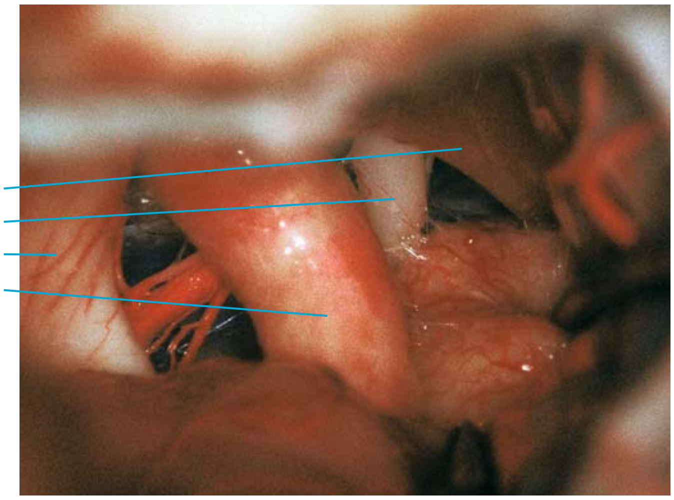


Fig. 2.0.30

Step 7

Using higher magnification, the ipsilateral suprasellar structures are again visualized. Note the anatomical windows between structures of the CN II, ICA, CN III and the anterior petroclinoid ligament. Through these windows the deep-seated prepontine and interpeduncular cisterns can be approached (Fig. 2.0.30).

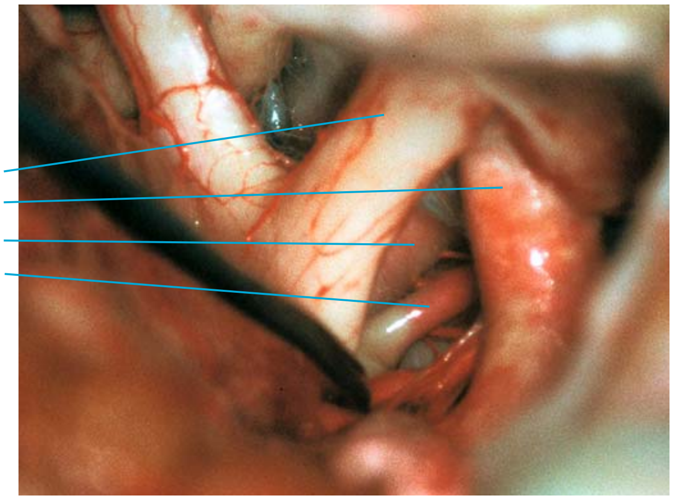


Fig. 2.0.31

Step 8

After further dissection, the deep-seated interpeduncular structures can be approached through the anatomical windows. In this case, the ipsilateral SCA and the basilar trunk are seen through the OPCA window (Fig. 2.0.31).

5. Dura, bone and wound closure

After completion of the intracranial procedure, the subarachnoid space is filled with artificial CSF solution at body temperature. The dural incision is closed watertight using either interrupted or continuous sutures. If dehiscence has developed in the dural opening, a piece of muscle can be sewn into the dural closure. A plate of gelfoam is placed extradurally. The bone flap is fixed with a titanium miniplate, closing the previously performed burr hole trephination. Note that the bone flap should be tightly fixed both medially and frontally to achieve optimal cosmetic results. After final verification of hemostasis, the muscular and subcutaneous layers are closed with interrupted sutures and the skin with a running suture or sterile adhesive tapes. On account of the limited skin incision and nontraumatic surgical technique, a suction drain is not necessary.

Potential errors and their consequences

- Inadequate preoperative planning and positioning of the patient with subsequent inadequate exposure of the target region and significant deterioration in efficiency of surgically excising the lesion. Planning and positioning is the task of the surgeon!
- The skin incision is performed too medially with consequent injury to the supraorbital nerve and postoperative frontal numbness.
- Penetration of the orbit during burr hole trephination with postoperative orbital hematoma and swelling.
- Overlooked, but rarely unavoidable injury to the dura during craniotomy. Dural reconstrucion may be necessary.
- Penetration of the frontal paranasal sinus. The opening should be closed with wax, periosteal muscle flap or abdominal fat to avoid postoperative CSF leak.
- Penetration of the orbit during extradural removal of osseous extensions of the orbital roof with postoperative orbital hematoma and swelling.
- Inadequate removal of CSF with injury to the frontal lobe due to spatula pressure.
- Injuries to numerous nerves and vessels in the parasellar region during microsurgical manipulation resulting in postoperative neurological deterioration.
- Inadequate intracranial hemostasis with subsequent rebleeding.
- Inadequate dural closure with postoperative CSF leak.

- Inadequate positioning and fixation of the bone flap.
- Inadequate hemostasis in the periorbital region causing post-operative soft tissue hematoma.

Tips and tricks

- Take time for preoperative planning and positioning of patients. The reward is an excellent overview of the target area and an efficient working position.

- For simple control of correct positioning of the patient's head, exposing the suprasellar region, note the following trick: the nasoorbital entrance touched by the flat hand should show a horizontal plane (Fig. 2.0.32).

- Make a careful anatomical orientation and use the three steps of marking with a sterile pen: 1. osseous structures and nerves; 2. placement of craniotomy; 3. skin incision.

- If the eyebrow is not dominant, the skin incision should be made in a crease or scar of the supraorbital area. Alternatively, an incision behind the hairline is also possible (Fig. 2.0.33).

- By retracting the soft tissue, the frontal muscle should be retracted downwards with two or three strong sutures to achieve sufficient overview of the frontal bone. Exposure and mobilization of the frontal and orbital muscle upward to the supraorbital rim should be restricted to the necessary minimum to prevent postoperative periorbital hematoma. Soft tissue should be carefully retracted to prevent postoperative necrosis (Fig. 2.0.34).

- Be careful during the burr hole trephination: adequate placement but inadequate direction of the burring procedure may also penetrate the orbit (Fig. 2.0.35).

- Stages of craniotomy (Fig. 2.0.36): 1. burr hole trephination; 2. frontobasal cutting with the craniotome parallel to the orbital rim in a lateral to medial direction; 3. sawing in a semilunar fashion from the burr hole to the medial edge of the former craniotomy line .

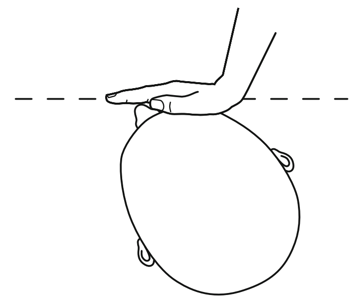


Fig. 2.0.32

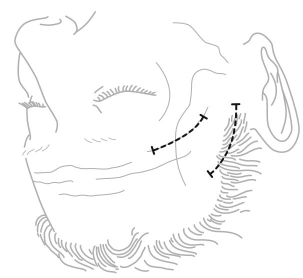


Fig. 2.0.33

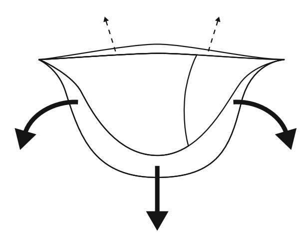


Fig. 2.0.34

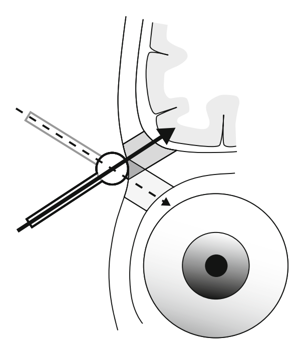


Fig. 2.0.35

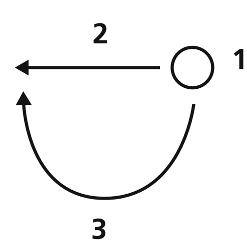


Fig. 2.0.36

Fig. 2.0.37

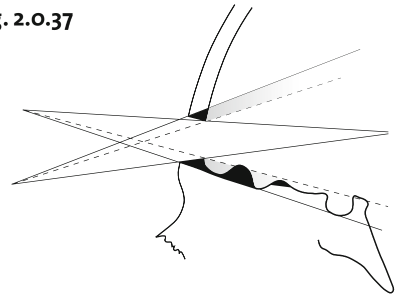


Fig. 2.0.38

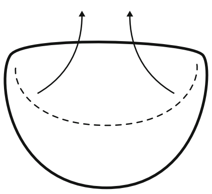


Fig. 2.0.39

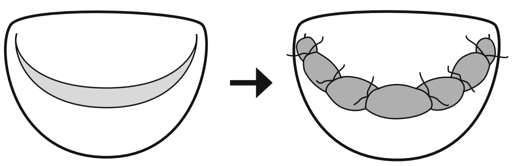


Fig. 2.0.40

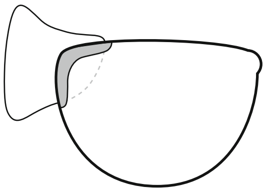
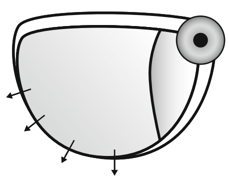


Fig. 2.0.41



- Drilling of the inner edge of the craniotomy after removal of the bone flap is important for limited approaches. Small osseous extensions of the orbital roof should also be carefully removed to provide an excellent overview and to allow microsurgical access to deep-seated sites (Fig. 2.0.37).

- Open the dura in a "C" shaped, semilunar fashion and hold the dural flap towards the supraorbital rim with two sutures (Fig. 2.0.38).

- After completion of the intradural dissection, dural closure should be made watertight using either interrupted or continuous suture. If dehiscence has developed in the dural opening, a piece of muscle can be sewn into the dural closure (Fig. 2.0.39).

- If the frontal paranasal sinus is penetrated, careful closure is required. Bone wax, a flap of galea or abdominal fat tissue can be used for this purpose (Fig. 2.0.40).

- After dural closure, the bone flap should be tightly fixed medially and frontally to achieve optimal cosmetic results. A titanium plate can be used for closure of the burr hole trephination (Fig. 2.0.41).

- The eyebrow skin incision should be closed with intracutaneous running sutures or with sterile adhesive tapes.

- On account of the limited skin incision and nontraumatic surgical technique, a suction drain is not required.