Cranio–nasal median splitting for radical resection of craniopharyngioma

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A new surgical approach for radical resection of craniopharyngioma is presented. This approach (cranio–nasal median splitting) involves craniotomy in the centre of the frontal bone, removal of the median portion of the supraorbital bar that incorporates the nasal bone, and detachment of the medial canthal ligaments. The frontal lobes, the cribriform plates, the planum sphenoidale, and the upper nasal cavities are split in the midline. The extraventricular surface of the hypothalamus, the pituitary stalk, and the posterior portion of the Willis' arterial ring are well visualized through the midline infrachiasmatic route. The intraventricular surface of the hypothalamus is also visible in the same operative field through the lamina terminalis and/or the anterior portion of the corpus callosum. This excellent visualization is quite helpful for minimizing operative injury to the hypothalamus and the pituitary stalk whichever surface of the third ventricular floor the tumour is situated upon. Three cases of craniopharyngioma operated upon by this approach are presented. Discussions are focused not only on the indication, but on the advantages and disadvantages of this approach. The surgical techniques for reconstruction of the cranial base are also described, together with some precautions that should be taken to prevent possible postoperative complications. [Neurol Res 1992; **14**: 345–351]

Keywords: Craniopharyngioma; cranial base surgery; radical resection; surgical technique

INTRODUCTION

When a craniopharyngioma is large enough to distort the suprasellar neurovascular structures, radical resection is still a challenging operation even with the refined techniques of microneurosurgery. The tumour often infiltrates the hypothalamus and the pituitary stalk, making the dissection quite difficult. In addition to this, the complex neural and vascular structures in the suprasellar area prevent any single procedure so far reported from providing a full view of the cleavage plane. The authors developed a new surgical approach that offers excellent visualization of the undersurface of the optic chiasm and the hypothalamus. The intraventricular surface of the third ventricular floor is also visualized through the lamina terminalis and/or the anterior portion of the corpus callosum. Whichever surface of the third ventricular floor the tumour is situated upon, excellent visualization of the both surfaces in the same operative field is quite useful for meticulous dissection of the tumour from the critical neurovascular structures. This approach (cranio–nasal median splitting) is, therefore, quite useful for radical resection of craniopharyngioma situated either outside or inside the third ventricle. The surgical techniques are described, and three cases of craniopharyngioma operated upon by this approach are presented. The surgical indication, merits, demerits, and some precautions required in this approach are also discussed.

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SURGICAL TECHNIQUES

Positioning, skin incision, and osteotomy

The patient is placed in the supine, slightly chin-up position so that the chiasma region can be approached both from above and from below the frontal cranial base. When the trans-lamina terminalis and/or trans-callosal view of the third ventricular floor is required, the upper portion of the operating table is tilted up. Sterilization and preparation include the upper half of the face so that the medial canthal ligaments may be palpable outside the scalp flap. A coronal incision, extending on both sides to the lower border of the zygomatic arch, is used. On both sides, the incision is placed just in front of the tragus to preserve all the branches of the facial nerve[1]. Before turn over of the scalp flap, a galeal-pericranial flap is prepared for the later reinforcement of the cranial base.

To gain a sufficient flap, the following technique is employed. In the midportion of the incision, the scalp is not incised through the full thickness. From the parietal scalp just behind the incision, the galea aponeurotica of about 3 × 3 cm (*Figure 1* left, shaded area) is detached together with the pericranium, and is attached to the frontal scalp flap. Subperiosteal turn over of the frontal scalp is carried out bilaterally to the level of the linea temporalis. Below the level of the linea temporalis, the dissection is done in such a way that the superficial temporal fascia are carefully dissected from the superficial lamina of the deep temporal fascia to preserve all the branches of the facial nerve in the scalp flap. The supraorbital nerve is freed from its canal bilaterally and is preserved in the frontal scalp flap.

Care should be taken not to compromise the

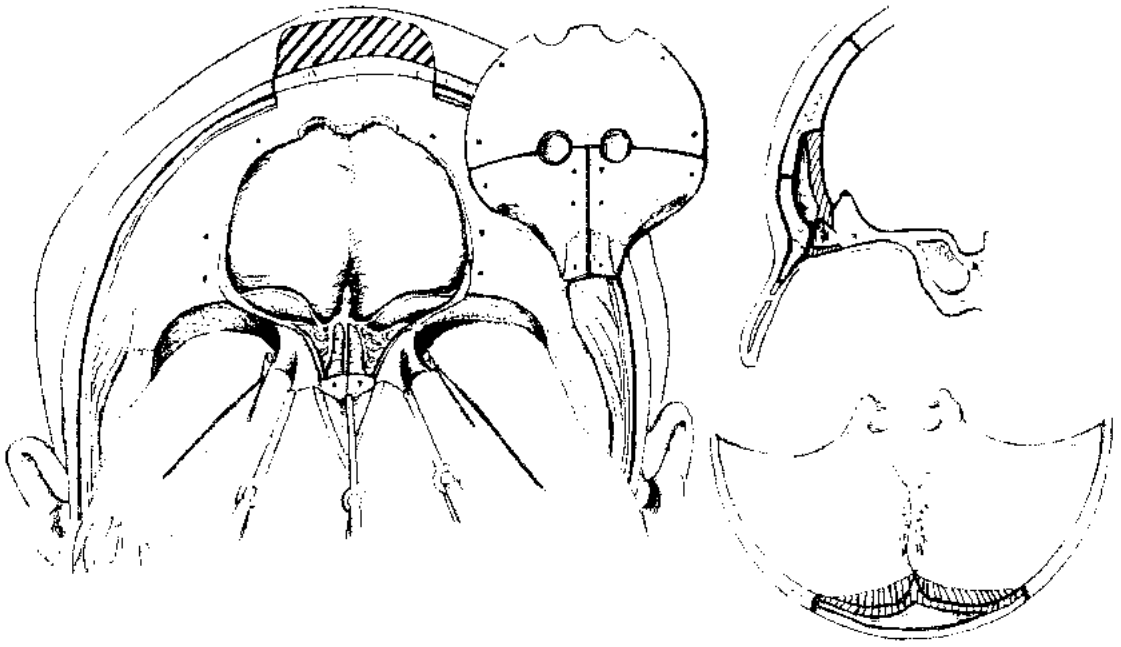

Figure 1: To supplement the pericranial flap for later reconstruction of the frontal cranial base, the galea aponeurotica and the pericranium of the central portion of the parietal scalp (left, shaded area) is attached to the frontal scalp flap. The frontal scalp is turned over subperiosteally, and on this flap a median incision is made into the pericranium and the procerus muscle. This incision, together with the detachment of the medial canthal ligaments (ligatures on the ligaments) and lateral displacement of the upper portion of the lacrimal sacs, facilitates extensive exposure of the nasal bone. Midline splitting of the median portion of the supraorbital bar is helpful to avoid injuring the mucous membranes of the nasal cavities. The inner tables of the frontal sinus, together with the mucous membranes, are removed from the bone flaps (right, shaded areas)

trochlear arteries, which are important feeders for the galeal-pericranial flap. The periorbita, in continuity with the periosteum, is detached from the superior and lateral wall of the orbit bilaterally in order to facilitate the downward reflection of the scalp flap. The medial canthal ligaments are identified, dissected, and detached bilaterally from the dacryon after ligatures are tightened upon them[2] (*Figure 1*, left). To help identifying the ligaments, the lower eye lids are pulled laterally. This technique increases the tension of the ligaments and is useful for identifying the ligaments under the scalp flap. For the convenience of later repositioning of the ligaments, small windows of the bone attached to the ligaments may be created in the lacrimal bones[3]. When the median portion of the supraorbital bar is repositioned near the end of the operation, these ligaments should be fixed to the former places using the ligatures and small holes made near the dacryon.

Following the detachment of the medial canthal ligaments, the periorbita is detached from the medial walls of the orbits. The upper half of the lacrimal sac is also mobilized bilaterally. On the reflected scalp flap over the nasal bone, a median incision is made into the pericranium and the procerus muscle (*Figure 1*, left). This incision, together with the detachment of the medial canthal ligaments and the lateral displacement of the upper portions of the lacrimal sacs, facilitate extensive exposure of the nasal bone.

After paramedian four burr holes are made, a 4 × 5 cm free bone flap is elevated in the centre of the frontal bone near the skull base. The frontal sinus is invariably opened; the bone flap is removed from the inner table and the mucous membranes, and is rinsed with an antibiotic solution. The mucous membranes and the inner table are also removed from the rest of the frontal sinus in the supraorbital bar (*Figure 1*, right). Using an oscillating bone saw and an air drill with a fine tip bar, osteotomy is carried out to remove the median portion of the supraorbital bar. This median supraorbital bar incorporates the frontal bone (the outer table of the frontal sinus), the upper two thirds of the nasal bone, and the superior medial portions of the frontal processes of the maxillary bone (*Figure 1*, left). To avoid injuring the nasal mucous membranes, the osteotomy line should not be placed too deep inside the medial and superior orbital rim. Using an oscillating bone saw, a midline osteotomy is carried out on this median supraorbital bar; this midline splitting, followed by spreading with the use of a chisel, is practically useful to prevent tears in the mucous

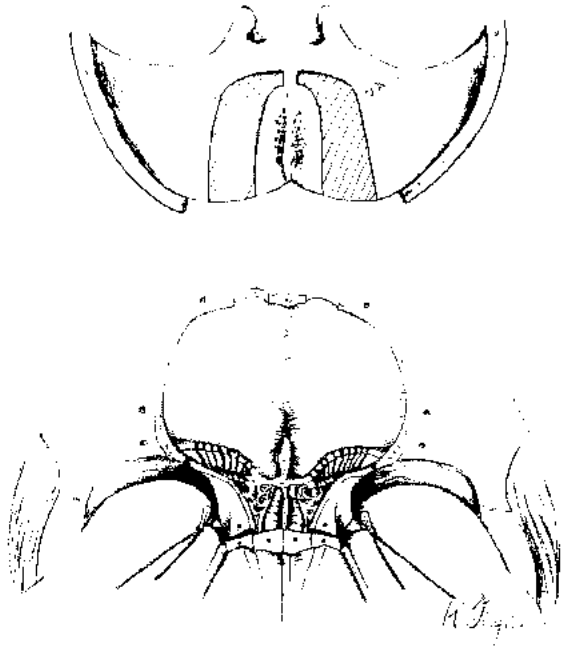

Figure 2: In the epidural space just lateral to the olfactory grooves, 1.5 cm wide gutters of bone defect are made (shaded areas). Behind the olfactory grooves these bone defects are approximated, leaving a 5 mm wide bone bridge in the midline between the cribriform plates and the planum phenoidale (upper). Guide osteotomies are made bilaterally on the lateral wall of the ethmoid sinus. These osteotomy lines are made bilaterally across the upper half of the lacrimal fossa, where fractures are made to facilitate the spreading of the upper nasal cavities (lower)

membranes of the nasal cavities (*Figure 1*, left). For the sake of later fixation of these bone flaps, several small holes are made on both sides of these cranio–orbito-nasal osteotomy lines. Near the frontonasal ducts, the rests of the mucous membranes of the frontal sinus are sutured bilaterally. The mucous membranes of the ethmoid sinuses are dissected and retracted backward. Muscle pieces are packed into these sinuses. Any tears, if present in the mucous membranes of the nasal cavities, should be sutured. The nasal cavities are separated submucosally, and the anterior portion of the upper nasal septum is removed.

Cranio–nasal median splitting

The following procedures are conducted with the use of the operating microscope. In the epidural space just lateral to the olfactory groove, the orbital roof is drilled off bilaterally, making 1.5 cm wide gutters of bone defect (*Figure 2*). Behind the olfactory grooves these bone defects are approximated, leaving a 5 mm wide bone bridge in the midline behind the crista galli (*Figure 2*, upper). This bone bridge is helpful to keep the cribriform plates stable during the later splitting in the midline. Because the medial portion of the orbital roof is usually pneumatized, the roof of the ethmoid sinus is opened bilaterally by the bone drilling so far carried out. The mucous membranes are pushed inside, and muscle pieces are packed into the ethmoid sinuses. Guide osteotomies are made bilaterally on the lateral wall of the ethmoid sinus. These osteotomy lines are made bilaterally across the upper half of the lacrimal fossa. The osteotomies are also extended on to the frontal processes of the maxillary bone, where fractures are made to facilitate the spreading of the upper nasal cavities (*Figure 2*, lower and *Figure 3*, lower). Small holes are made on both sides of these bone cuts for the convenience of later fixation. The dura is opened horizontally near the frontal base and across the midline. The sagittal sinus and the falx are cut above 0.5 cm above the crista galli, the frontal base dura mater is incised in the midline, and the basal attachment of the falx is separated between its two dual leaves to expose the crista galli.

After drilling off the crista galli, the cribriform plates are split in the midline, using an air drill with an extra-fine tip diamond bar in the space both above and below the frontal cranial base (*Figure 3*, upper). The frontal lobes are separated further, and the dura over the planum sphenoidale is cut in the midline toward the tuberculum sellae. The cut edges of the dura mater are separated, and the planum sphenoidale is drilled off in the midline, making a bone defect 2.0 cm wide at the anterior end and 1 cm at the tuberculum sellae (*Figure 3*, upper). Using the technique of the transseptal

Figure 3: After drilling off the crista galli, the cribriform plates are split in the midline, using an air drill with an extra-fine tip diamond burr. The median splitting is performed toward the tuberculum sellae (upper). The nasal cavities are separated transseptal submucosally, and the anterior wall of the sphenoid sinus as well as the upper portion of the nasal septum is removed. The cranio-nasal median splitting is accomplished by crushing the medial walls of the ethmoid sinuses and by making fractures along the guide osteotomies on the lateral walls of the bilateral ethmoid sinuses (lower)

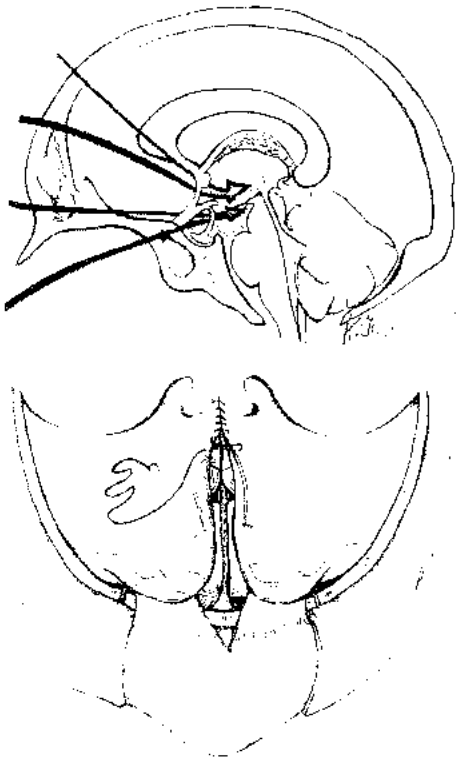

Figure 4: Combined supra- and infra-chiasmatic approach (upper, arrows) is useful for inspecting the third ventricular floor both from inside and from outside the ventricle, and thereby minimizing injury to the critical neurovascular structures. The lower figure shows reconstruction of the anterior cranial base. The galeal–pericranial flap is divided in the midline and is inserted epidurally through the craniotomy gap between the frontal bone flap and the supraorbital bar. The midline dural incision is sutured together with the galeal - pericranial flap, using a 0.6 cm long, taper cut, 3/8 circle needle with 6-0 nylon monofilament.

submucosal approach, the rest of the upper portion of the nasal septum is removed, and the anterior wall of the sphenoid sinus is drilled. If the mucous membranes of the sphenoid sinus are torn, the membranes are retracted and muscle pieces are packed into the sinus. The cranio–nasal median splitting is accomplished, by crushing the medial walls of the ethmoid sinuses and by making fractures along the guide osteotomies on the lateral walls of the bilateral ethmoid sinuses. (*Figure 3*, lower). By drilling off the bony walls of the sphenoid sinus further, the median splitting can be extended toward the floor of the sella turcica. If precise inspection of the intrasellar compartment is required, the anterior portion of the sellar floor is drilled and the underlying dura is incised in the midline. Usually, however, splitting toward the tuberculum sellae is sufficient enough to gain an excellent view of the undersurface of the optic chiasm, and the hypothalamus.

Combined infra- and supra-chiasmatic approach

If the tumour is located underneath the hypothalamus, the working space is obtained primarily in the infrachiasmatic suprasellar area (*Figure 4*, lower arrow). An excellent view is obtained for the undersurface of the hypothalamus and for the pituitary stalk. The mamillary bodies, the interpeduncular fossa, the posterior portion of the Willis' arterial ring and the pertinent perforating vessels are also well visualized. Neither the optic nerves, the carotid arteries, or the posterior communicating arteries and their branches interfere with the full view of these critical neurovascular structures. If the tumour is situated within the third ventricle, the suprachiasmatic, trans-lamina terminalis and/or trans-callosal approach is used (*Figure 4*, upper arrow). If wider working space is required, the anterior communicating artery is severed after doubly ligating with 8-0 nylon monofilament. Ligation is safer than clipping to preserve the small perforating branches coming off from the anterior communicating artery. Whichever surface of the third ventricular floor the tumour is situated upon, a combined supra- and infra-chiasmatic approach is used for a large craniopharyngioma. During dissection of an intraventricular craniopharyngioma inspection of the pituitary stalk and observation of the extraventricular surface of the hypothalamus are quite helpful for preventing perforation of the hypothalamus. Likewise, during resection of an extraventricular suprasellar craniopharyngioma, the risk of perforating the hypothalamus is greatly reduced by inspecting the third ventricular floor through the lamina terminalis and/or the anterior portion of the corpus callosum. If the optic chiasm is prefixed and posterior upward extension of the tumour is large, bitateral optic canal decompression is performed epidurally to elevate the optic nerves. The optic sheaths are incised bilaterally along the medial borders of the optic nerves, but these incisions should be sutured later with the lateral margins of the epidurally inserted pericranial flaps.

Frontal base reconstruction

After the tumour resection, the median supraorbital bar is repositioned and fixed with ligatures. The fractured portion of the frontal process of the maxillary bone is also repositioned and fixed bilaterally to the nasal portion of the median supraorbital bar. The lateral wall of the ethmoid sinus (the medial wall of the orbit) is also repositioned bilaterally. Before closure of the craniotomy, a pericranial flap is dissected from the frontal scalp for the use of reinforcement of the frontal cranial base. This flap is 4 cm wide at the most proximal portion, tapered gradually, and 2 ~ 3 cm wide distally. The galeal attachment of the flap may be resected if the pericranial flap is substantial enough to cover the frontal base epidurally. The flap is cut in the midline and is inserted epidurally through the osteotomy gap between the supraorbital bar and the craniotomy bone flap. The osteotomy gap between the supraorbital bar and the frontal base can also be used for the insertion of the flap. The bone defects lateral to the cribriform plates are covered bilaterally by this flap. On the planum sphenoidale and on the tuberculum sellae, the distal portions of the flap are approximated to cover the midline bone defect. Closure of the midline dural incision is not difficult by the use of a 0.6 cm long, taper cut, 3/8 circle needle with 6-0 nylon monofilament. Over the bone defect of the planum sphenoidale, a running suture is performed on the midline dural incision together with the approximated cut edges of the pericranial flap (*Figure 4*, lower). This running suture is continued on to the two leaves of the basal

Figure 5: Case 1. Pre- and post-operative CTs. This is a recurrent case of intraventricular craniopharyngioma removed by the cranio–nasal median splitting in the second operation

attachment of the falx, and then on to the midline incision of the frontal dura mater. Following the closure of the horizontal dural opening, the craniotomy bone flap is replaced and fixed, and an epidural drainage is placed for 24 hours postoperatively. The scalp flap is closed in two layers, and an elastic bandage is applied mildly over the forehead. The nasal cavities are packed by pieces of gauze with antibiotic ointment.

CASE REPORTS

Case 1

A thirty one year old man had one year history of impotence, polyuria, and bitemporal hemianopia. In June 1988, he underwent subtotal resection of a craniopharyngioma in the third ventricle through the trans-lamina terminalis approach (*Figure 5*, left). In this approach a portion of the tumour was left in the anterior third ventricle because this portion (about 1 × 1 × 1 cm) was hidden under the optic chiasm and total resection appeared to risk a perforation of the hypothalamus. After this operation, he was anosmic on the right side and slightly hyposmic on the left. He was put on hydrocortisone 7.5 mg day^{-1} and carbamazepine 400 mg day^{-1}. His visual field impairment improved slightly and his urine volume was controlled to be within 1000 ml day^{-1}. He received irradiation of 45 grey, but the tumour grew gradually during the next two years and reached the size of 2 × 2 × 2 cm in August 1990. His visual field deteriorated in the left eye, severely constricting and narrowing. He underwent the second operation in September 1990 through the cranio–nasal median splitting. The cribriform plates were split on the right side along the base of the crista galli. The pituitary stalk, the undersurface of the third ventricular floor and the pertinent perforating vessels were well visualized through the infrachiasmatic route. The excellent visualization of these critical structures helped greatly the total resection through the suprachiasmatic route. All the perforating vessels were preserved, and no perforation of the hypothalamus occurred (*Figure 5*, right). His visual field improved to be temporal upper quadrantic hemianopia in the right eye and temporal hemianopia in the left. He was continued on the same replacement therapy; his impotence, urine volume, and impairment of smelling remained the same. He returned to his previous work and has been working as a guard in a business building.

Case 2

A thirty one year old house-wife developed bitemporal hemianopia, amenorrhea, galactorrhea, polyuria of 3000 ~ 4000 ml day^{-1}, and weight gain of 20 kg during the past one year. In September 1990, she underwent total resection of a craniopharyngioma in the third ventricle (*Figure 6*, left) through the cranio–nasal median splitting. The tumour was totally removed without creating a perforation of the hypothalamus. The pituitary stalk and the perforating vessels to the hypothalamus were also preserved (*Figure 6*, right). Immediate postoperative CT scanning showed substantial dead space in the bifrontal epidural area, and this space was replaced by a collection of fluid and air. She had no postoperative leakage of the cerebrospinal fluid and was well until the seventh postoperative day when she developed spiky fever and swelling of the forehead. CT scanning revealed a low-density fluid collection in the bifrontal epidural space; the density of the fluid was slightly higher than that of the cerebrospinal fluid. Based on her clinical course and the above described CT findings, she was diagnosed to have a postoperative epidural abscess. Systemic antibiotics were started, the frontal bone flap and the median spraorbital bar were removed, and the epidural space was drained and irrigated with an antibiotic solution for two weeks. The open wound for the irrigation spontaneously closed within one week, and she did not develop febrile again. The splitting of the cribriform plates was done on the right side along the base of the crista galli, and she became severely hyposmic on the right. She was put on carbamazepine 200 mg day^{-1}. Her urine volume reduced to 1000 ml day^{-1} and her galactorrhea ceased, but her body weight and amenorrhea remained the same. Her visual field improved to be partial upper quadrantic hemianopia on both sides. She returned to house work and is waiting for a cranioplasty operation.

Case 3

A forty five year old carpenter had a two year history of bitemporal hemianopia, impotence, and weight gain

Figure 6: Case 2. Pre- and post-operative CTs. This case is an intraventricular craniopharyngioma, complicated by epidural abscess after the cranio–nasal median splitting

Figure 7: Case 3. Pre- and post-operative MRIs. The tumour was situated extraventricularly on the suprasellar area. The pituitary stalk was preserved through the cranio–nasal median splitting

of 20 kg. In December 1990, he underwent total resection of a craniopharyngioma in the suprasellar, extra-third ventricular area through the cranio–nasal median splitting (*Figure 7*, left). The tumour was tightly adhered to the pituitary stak and to the right side of the under surface of the hypothalamus. During the resection of the tumour, the third ventricular floor was carefully inspected both from inside and from outside the ventride, but complete resection of the tumour caused a perforation 0.5 × 0.5 cm wide in the right hypothalamus. The pituitary stalk and the perforating vessels to the hypothalamus were preserved (*Figure 7*, right). The galeal-pericranial flap was not sufficient to plug up the dead space created by the removal of the inner tables of the frontal sinus. To supplement the filling of the dead space, pedicled flaps were made bilaterally with the anterior one third of the superficial lamina of the deep temporal fascia. These flaps were turned over without compromising their attachment on the linear temporalis. The patient's postoperative course was benign and uneventful, except that dexamethasone and endonasal spray of DDAVP (desamino-cis-1-8-1D-arginine vasopression) were administered in the acute postoperative period. Although the splitting was strictly in the midline, he had hyposmia on the right side. His visual field showed substantial recovery with only partial narrowing in the bitemporal upper quadrantic fields. His urine volume was controlled under 1000 ml day^{-1} without any replacement therapy, and he returned to the previous work in February, 1991.

Summary of the cases

No cosmetic problems such as telecanthus or deformity in the naso–orbital region were experienced, except in one patient (case 2) who underwent removal of the frontal bone and the median supraorbital bar. No disturbance of lacrimal function was experienced in any patients. In all patients postoperatively, the extraocular movements were normal and the visual field impairments showed substantial improvement. All the patients returned to their previous work under satisfactory control of urine volume. No cerebrospinal fluid leakage was experienced in any of our patients although one patient (case 2) developed postoperative epidural abscess. All the patients had postoperative hyposmia of various severity. The latter two points, i.e. infection and hyposmia, appear to require further discussion.

DISCUSSION

General consideration and merits of the cranio–nasal median splitting

The optimal treatment of craniopharyngiomas has long been a controversial subject; some workers advocate radical resection[4–6], while others recommend partial resection combined with irradiation[7–12] and/or chemotherapy[13,14]. However, a comprehensive discussion on the indication for radical resection is not the primary purpose of this report. For radical resection of craniopharyngiomas, excellent visualization of the cleavage between tumour and the neurovascular structures is considered to be mandatory. In the following discussion, therefore, obtainable intraoperative views are compared in various approaches in order to clarify the surgical indication of the cranio–nasal median splitting. Technical difficulties as well as the morbidity and mortality of the radical resection are reported to increase as the size of the tumour increases. For small craniopharyngiomas confined within the sella turcica, transsphenoidal approach appears to be indicated[15,16]. For suprasellar craniopharyngiomas that is not large enough to encroach upon the foramina of Monro, the conventional fronto–temporo–basal approach may provide fairly sufficient visualization of the cleavage plane. In larger tumours, however, the optic nerve, the carotid artery, and the posterior portion of the Willis' arterial ring interfere on the ipsilateral side with the full view of the cleavage between tumour and the neurovascular structures.

Extended basal craniotomy techniques, such as the orbito——zygomatic approach[17] and trans-petrosal approach[18] are indicated for posterior upward extension of suprasellar craniopharyngioma. These approaches also are oblique approaches and have the same problem as the pterional approach. The complex neurovascular structures on the approached side always interfere with the full view of the cleavage plane. In addition to this problem, they are not indicated for intraventricular craniopharyngiomas. For intraventricular craniopharyngiomas the interhemispheric trans-lamina terminalis and/or trans-callosal approach is indicated. In this approach, however, the anterior pole of a large tumour is always hidden underneath the chiasm, and total resection often causes perforation of the anterior hypothalamus. The combined pterional and trans-callosal approach[19] may offer the view of the hypothalamus both from outside and from inside the third ventricle. This technique, when used in large tumours however, requires manipulation in two different routes without providing visualization of the extra- and the intra-ventricular surfaces of the hypothalamus in the same operative field. Irrespective of the size of the tumour, the cranio–nasal median splitting enables the surgeon to gain excellent views of both surfaces of the third ventricular floor in the same operative field.

Demerits and precautions

One of the inherent demerits of the cranio–nasal median splitting is the possible risk of infection because the frontal cranial base is drilled, the paranasal sinuses are opened, and even the nasal cavities may be entered. In order to lessen the risk of infection, the following precautions should be taken. The frontal sinus should be removed from the mucous membranes and the inner table. The resets of the mucous membranes should be sutured bilaterally near the frontonasal ducts. The mucous membranes of the ethmoid and the sphenoid sinuses should be retracted, and muscle pieces should be packed into these sinuses. Any tears of the mucous membranes of the nasal cavities should be sutured meticulously. In addition to these precautions a pericranial flap should be prepared to shield the frontal cranial base epidurally. The opening of the paranasal sinuses and the suture lines of the nasal cavities should also be sealed by the pericranial flap. The frontal base dura mater should be closed meticulously, together with this pericranial flap; the closure of the frontal base dura is facilitated by the use of a small nontraumatic needle with 6 ~ 0 nylon monofilament.

Removal of the inner table of the frontal sinus sometimes creates substantial dead space, leading to an epidural collection of fluid and air which can easily cause an infection as was experienced in the second patient. Therefore, the pericranial flap should be substantial enough to plug up this dead space. For this purpose, the pericranial flap is supplemented by the galea aponeurotica and split in the midline. One of the paired flaps can be used for the dural closure in the midline cranial base, and the other be used for the filling of the epidural dead space. If this galeal–pericranial flap is also insufficient, pedicled flaps can be made bilaterally by the temporal fascia to supplement the filling of the dead space. It is also advisable in the acute postoperative period to apply an elastic bandage on the forehead and to pack the upper nasal cavities with pieces of gauze with antibiotic ointment. These measures are also useful to prevent subcutaneous and submucosal collection of exdates and to lessen the risk of infection.

Another demerit of this approach is the possible risk of injury to the olfactory nerves. Bilateral medial groups of the olfactory fila approximate very closely in the midline where they perforate the base of the crista galli. They are so closely approximated in some cases that the median splitting is apt to damage the medial groups of the olfactory fila bilaterally. In such cases, paramedian splitting may be advisable to protect the olfactory nerve at least on one side. In the paramedian splitting, the cribriform plates are split on one side along the base of the crista galli, and the uppermost portion of the nasal mucous membranes are not detached on the other side from the nasal septum. Preservation of olfactory function on one side at the risk of the other may be more acceptable than severe hyposmia on both sides. Recent advances with contact LASER knife may enable ultra-fine splitting of the cribriform plates, securing the olfactory function bilaterally.

CONCLUSION

The cranio–nasal median splitting has two major demerits, i.e. the risk of infection and hyposmia. The precautions to prevent these possible complications are somewhat troublesome to take, requiring intimate cooperation with plastic surgeons and/or otorhinolaryngic surgeons. This operation, therefore, cannot be recommended as a standardized technique in the treatment of craniopharyngioma. Our recently increasing experience with cranial base surgery, however, has prompted us to apply this operation to radical resection of craniopharyngioma. In our patients, the demerits described above were outweighed by the excellent intraoperative view and the encouraging results. In conclusion, although our experience has been limited to date, the cranio–nasal median splitting is worthy of consideration for radical resection of a large craniopharyngioma either outside or inside the third ventricle.

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