

# Indications for the trans-sphenoidal approach of the hypophyseal fossa

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By 31st December 1971, our experience of trans-sphenoidal surgery had covered 490 cases, spread over a period of 15 years. A large number of operations had been carried out in co-operation with our friend, Dr. Jean Bouche. Originally exclusively used for the exeresis of pituitary tumors, the trans-sphenoidal approach was subsequently used also for other indications: craniopharyngioma, "empty sella" combined with disorders of vision; trans-sphenoidal rhinorrhea and, lastly, functional hypophysectomy for diabetic retinopathy or breast cancer metastases (Table I).

Yet pituitary adenomas were by far the most numerous, namely 437 out of 490 cases. These will therefore form the main subject of our report.

## THE CASES FOR TRANS-SPHENOIDAL SURGERY

HYPOPHYSEAL TUMORS	- Adenoma - Craniopharyngioma - Other tumors - Cyst
SPHENOIDAL TUMORS	- Chordoma - Other tumors
SPHENOIDAL SINUSITIS	- Mucocele - Empyema
TRANS-SPHENOIDAL RHINORRHEAS	- Spontaneous - Traumatic - Neoplastic - Postoperative - Post R * implantation
SYMPTOMATIC EMPTY SELLA	- Headaches, obesity, visual and/or endocrine symptoms - rhinorrhea
FUNCTIONAL HYPOPHYSECTOMY	- Breast cancer - Diabetic retinopathy

Table I

## PITUITARY ADENOMAS

It is not a matter of preference being given to the trans-sphenoidal approach of a pituitary adenoma as opposed to the intra-cranial method. Either has its specific indications. Hence one must be acquainted with both techniques and choose the one best suited to a given case.

The choice will above all be determined by the anatomical form of the adenoma and by its delimitation.

When an adenoma is of regular, round or oval shape it can be extirpated by the trans-sphenoidal method. When a pituitary adenoma is irregularly shaped and

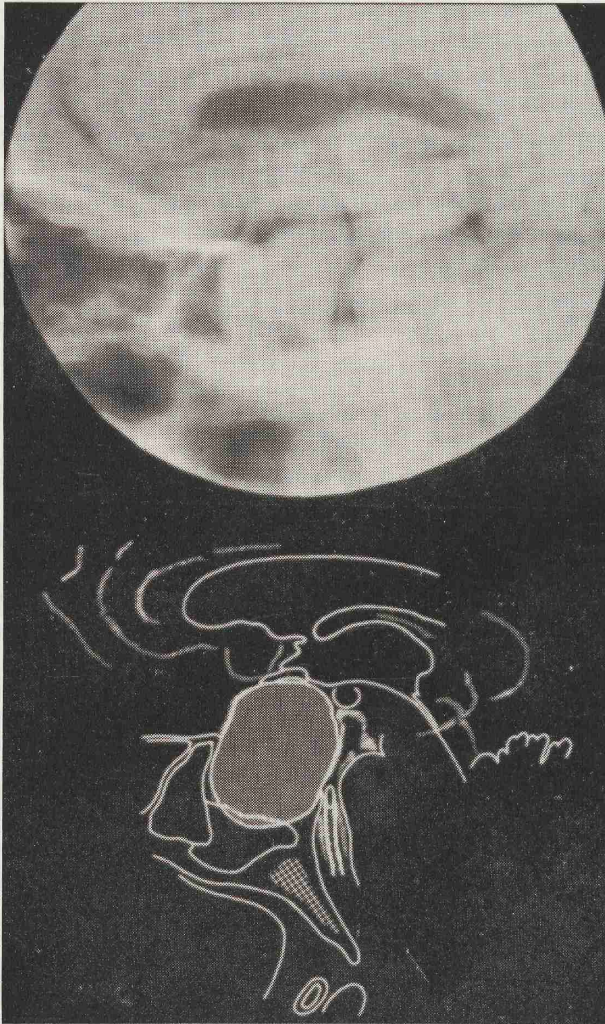


Figure 1a. A pituitary adenoma with an important suprasellar extension. As its morphology is that of a global and enclosed adenoma, the transsphenoidal approach is suitable here.

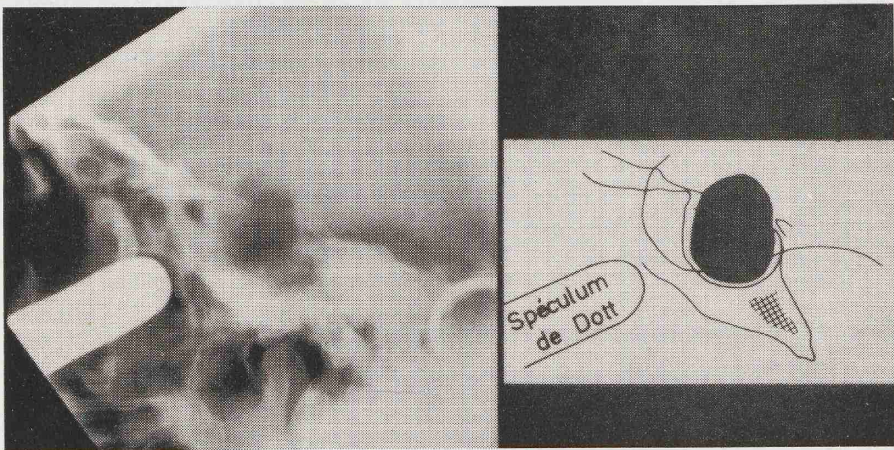


when, in particular, the intra-sellar part of the pituitary adenoma is separated from its supra-sellar (or extra-sellar) part by a narrow neck, it must be extirpated by the intra-cranial method. This is the schematic division of pituitary adenomas according to their morphology.

This latter is best defined by osteotomography and by pneumo-tomo-encephalography. Angiography is certainly also interesting in this context but it does not furnish any information on the morphology of the tumour comparable to that obtained from pneumo-tomo-encephalography, with renders possible a delimitation of the entire contour of the tumour, with the single exception of the lateral walls of the sella turcica. (The location of these walls could only be defined by opacification of the sinus cavernosus: this presents a more difficult investigation whose results remain uncertain and which, frankly, does not appear to be indispensable.)

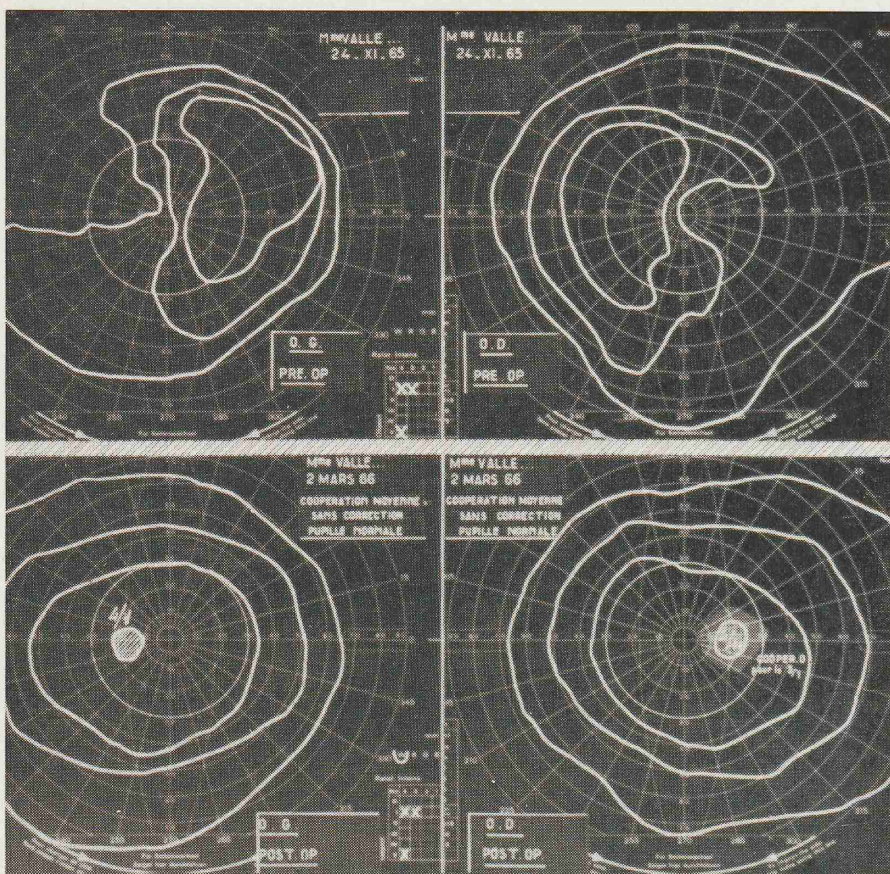
#### *Enclosed and regularly-shaped adenomas*

Pituitary adenomas of regular shape which moreover are fully enclosed by the dural envelope of the hypophyseal fossa constitute an excellent indication for the trans-sphenoidal method. The volume matters little (Figure 1). Even if there is a considerable supra-sellar expansion, the tumor can be extirpated in toto from the lower end because as a rule it is of soft consistency. Once the intra-sellar part of the pituitary adenoma has been evacuated, the supra-sellar part moves down spontaneously to the level below and is evacuated in turn. Moreover the curetting and suction instruments can be freely inserted into the tumoral fossa which is enclosed and separated from the subarachnoid spaces by the dural sheath, that is to say by the distended, yet continuous diaphragma sellae. Very often the pituitary adenoma has a really fluid consistency: it flows spontaneously into the



1b. Complete evacuation of the adenoma, as demonstrated by the aeric filling of the tumoral cavity.





1c. Visual result 3 months after surgery: complete disappearance of the preoperative bitemporal hemianopia.

sinus sphenoidalis as soon as the dura mater has been pierced; in other instances, the adenoma is cystic or in other cases again it is suffused with blood and transformed into a red pulpy mass, even into a true haematoma which can be evacuated by the simplest of operations.

#### *Pituitary adenomas with sphenoidal expansion*

(1) The first aspect is that of a pituitary adenoma which has considerably depressed the floor of the sella turcica. However, the floor is continuous; the sinus sphenoidalis, reduced to a thin crescent, is perfectly discernible on the radiographies and allows free access to surgical intervention. Here the indication for a trans-sphenoidal approach is simply preferential.



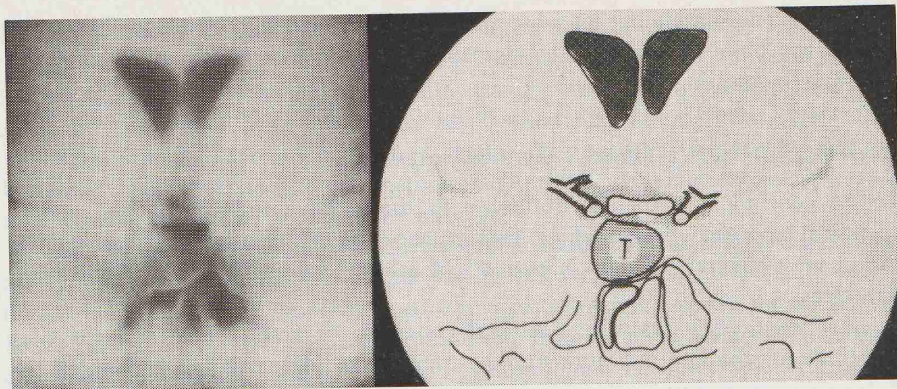


Figure 2. A so-called micro-adenoma developed within the basal and lateral wing of the hypophysis. It lowers the floor of the sella on the right and it does not elevate the diaphragm. The chiasma is free within the chiasmatic cisterna and clearly seen here with its dumb-bell shape above the sella. A good indication for micro-transsphenoidal surgery.

If the adenoma in question is of the secreting type (which may cause acromegaly, Cushing's disease, or galactorrhoea), it can be detected at a very early stage when it is no more than a micro-adenoma (Figure 2). In that case trans-sphenoidal microsurgery is indicated.

(2) The second aspect is that of a pituitary adenoma which has invaded the sinus sphenoidalis and/or the squamosphenoid itself (Figure 3). In such cases the trans-sphenoidal approach is absolutely indicated. And here is why: From the anatomical point of view, this approach is logical; conversely, the intra-cranial approach for operating on an intra-sinusal expansion of this type would imply the risk of a meningeal infection and in addition, the even greater risk of a post-operative rhinorrhoea.

The frequency of such invasions — 25% of the cases if one is to include even minute modifications in the bones revealed by tomography (particularly by hypocycloid tomography furnished by the "polytome") — remains a source of surprise. In its first stage it is the rupture in the sellar contours at one point, and sometimes even on one of the tomograms only. In a next stage, the perforation is larger and more evident. Lastly, we observe the image of an intra-sinusal opacity, generally blurred and irregular, since a pituitary adenoma has no proper capsule.

When the sinus sphenoidalis is exiguous or of the anterior type, the tumoral invasion may preferentially affect the squama of the clivus itself which would then display signs of osteolysis. The destruction of the bone substance may extend to a large part of the sphenoid and may even affect it in its entirety up to the lower point of the clivus (6 cases).

These vast destructions occur preferentially in recurrent pituitary adenoma which

had undergone surgery but no subsequent radiation treatment. They may be accompanied by complications such as spontaneous rhinorrhoea which might again be followed by meningitis.

*Adenomas in elderly subjects and acute adenomas*

Let us conclude the chapter dealing with the positive indications for a trans-sphenoidal approach by describing two instances where this method is absolutely indicated: pituitary adenoma in patients of advanced years, and acute intra-sellar hypertension.

— *Advanced years* (as also a general condition of frailty in young patients) constitute an absolute indication for the trans-sphenoidal approach because of the

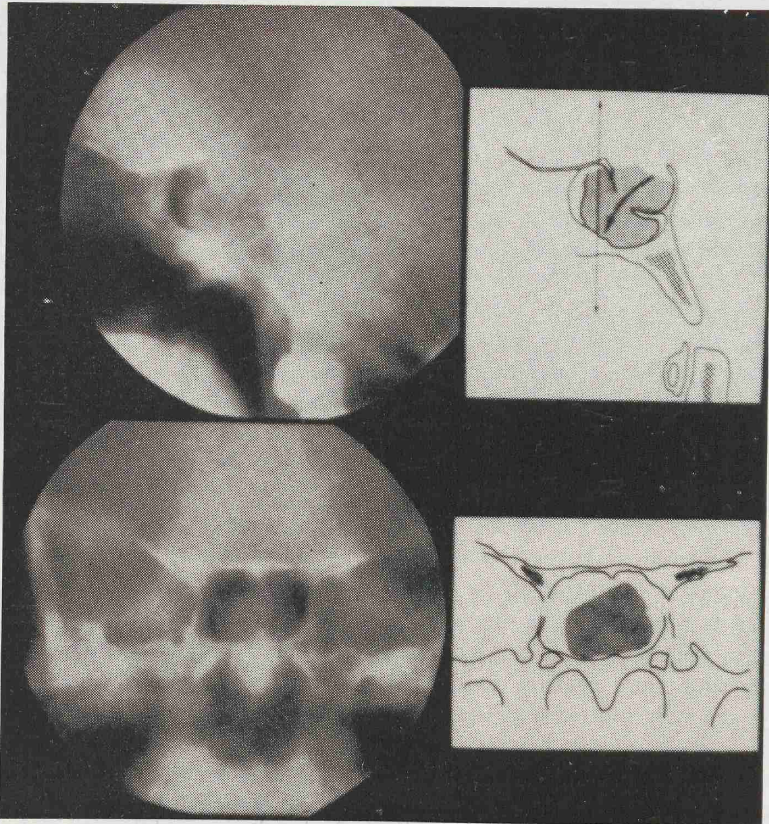


Figure 3. A pituitary adenoma with invasion of the sphenoidal sinus. Sagittal (top) and frontal (bottom) tomographic views of the lesion. The plan of the frontal section is indicated by the arrow on the sagittal section. An absolute indication for the transsphenoidal surgery.



benign character of this type of intervention. Thirteen of our patients were over 70 years of age. True, we lost two of them. On the other hand it is quite certain that there comes an age when any intra-cranial intervention becomes a matter of chance; moreover, once the subject has reached the age of 70 and over, this latter method should be rejected as a matter of principle, despite the risk of blindness. The trans-sphenoidal method has proved its efficaciousness in 11 of our patients, the oldest of whom was 79.

— *Acute intra-sellar hypertension* causes violent headaches, an abrupt diminution of sight and frequently also oculomotor paralyses. To this symptomatic triad is sometimes added a meningitic syndrome and/or an acute suprarenal insufficiency syndrome. Knowledge of an earlier amenorrhoea and the finding of an enlarged sella turcica allow to recognize its aetiology. This syndrome may be induced by oestrogens prescribed for amenorrhoea whose cause, however, was overlooked. For the same reasons of benignity, the trans-sphenoidal method is absolutely indicated here and its results are as a rule excellent. (Tables II and III).

TRANSSPHEOIDAL SURGERY  
FOR PITUITARY ADENOMAS

POST-OPERATIVE VISUAL RESULTS

	INITIAL	FOLLOW-UP
Return to		1967
NORMAL VISION	42.6%	36 %
IMPROVEMENT	49.1%	46.5%
FAILURE		
unchanged ... 4.8		
or	8.3%	17.5%
worse ..... 3.2		
	1967	1970
NORMAL VISION	47 %	44%
IMPROVEMENT	43.4%	43%
FAILURE		
unchanged		
or	9.6%	13%
worse		

Table II. Assessment of visual results after transsphenoidal surgery within two periods of time (1) before 1967 (2) between 1967 and 1970. In both periods the follow-up shows a loss among the good results; this loss is due (1) either to a recurrence of the tumor (7 cases) (2) or to a secondary visual pathology related to an empty sella (3) or to a physiologic loss of vision in elderly patients.

The statistics are better for the second period; mainly because the patients were referred earlier. As it is well known that the postoperative visual results depend essentially upon the severity and the duration of the preoperative visual impairment.

TRANSSPHENOIDAL SURGERY  
FOR PITUITARY ADENOMAS  
OPERATIVE MORTALITY

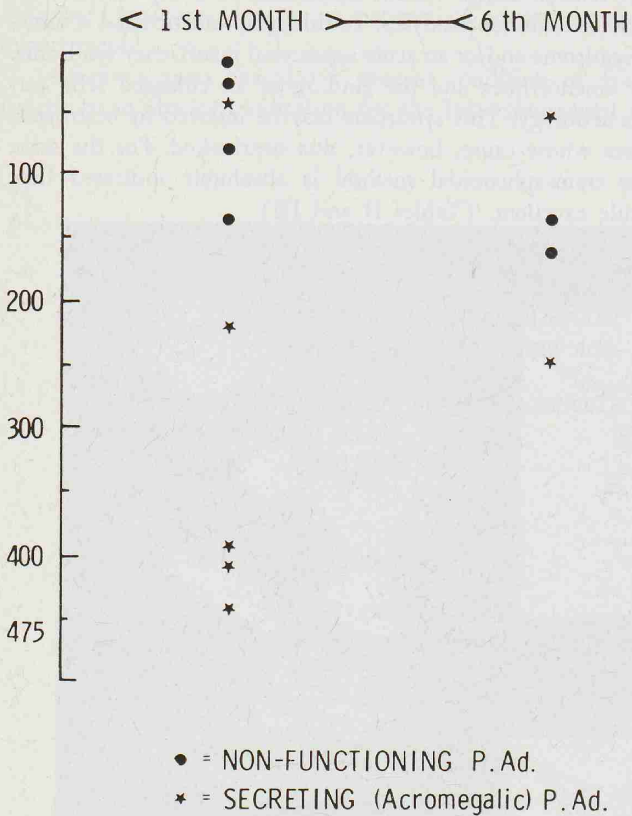


Table III. Statistics established at the time of the 475th patient. It is noteworthy that the last patient who died of a chromophobe adenoma was the 127th one; and that the mortality over the 225 last patients concerns only acromegalic patients with a pan-invasive adenoma.

*Contra-indications of the trans-sphenoidal method*

These are the irregularly shaped adenomas and intra-cranial invasive adenomas. Irregularly shaped pituitary adenomas whose intracranial part is inaccessible to curetting instruments must be extirpated from above. This also applies to adenomas which have destroyed, and gone beyond, the dural sheath of the hypophyseal fossa. This group covers approximately 10 to 12% of the pituitary adenomas we have observed (Figure 4).

The neck separating the suprasellar from the intrasellar part of the pituitary



adenoma may be located between the chiasma and the tuberculum sellae and the suprasellar adenoma develops below the frontal lobes rather like a meningioma of the tuberculum sellae. It may be located laterally between the optic nerve and the carotid (or between the carotid and the sinus cavernosus) and the tumor develops in the frontal fossa (right or left) where it may acquire an incredibly large volume.

Strangely enough, these voluminous, balloon-shaped tumours cause the least endocrinous deficit. Probably the escape of the tumor outside the sella turcica prevents the normal hypophysis to be compressed, as it is by an endosed adenoma. Lastly, the neck may be retro-chiasmatic and the tumor, capped by the floor of the third ventricle, develops in the space provided by this cavity or again between the roof of the sinus cavernosus and the optic tract (producing homonymous hemianopsia and not a bitemporal one as well as affecting the third cerebral (oculomotor) nerve) and the tumor develops in the temporal fossa. This latter variety of diffusion forced us to operate on several patients by both methods: first by the trans-sphenoidal method and subsequently by the trans-temporal method.

#### OTHER INTRA-SELLAR LESIONS

Apart from the adenoma, the most frequent intra-sellar tumor is the *craniopharyngioma*. However, the point of origin as well as the main growth of the craniopharyngioma is supra-sellar; it is attached to the pituitary stalk and is in contact with the vasculo-neural elements of this area and lies close to the hypothalamus. In exceptional cases, the craniopharyngioma is exclusively intra-sellar and then rightly constitutes an indication for the trans-sphenoidal approach.

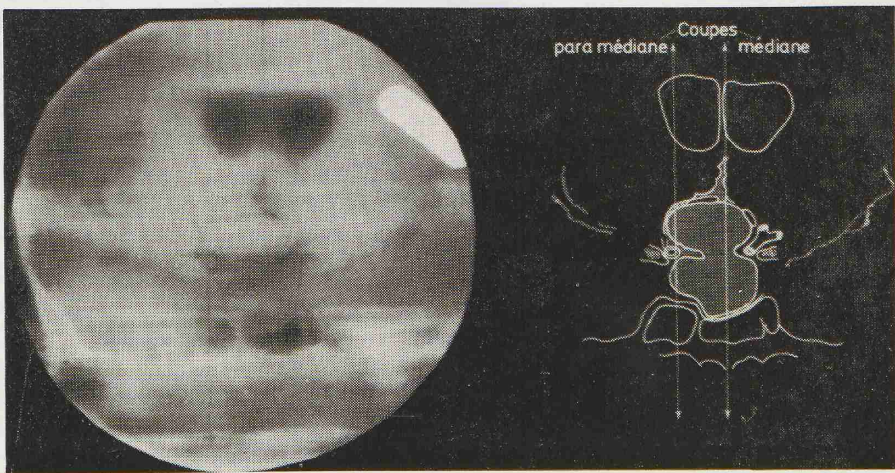


Figure 4. A pituitary adenoma with a suprasellar expansion separated from the intra-sellar portion by a rather narrow neck. Absolute indication of the intracranial approach.



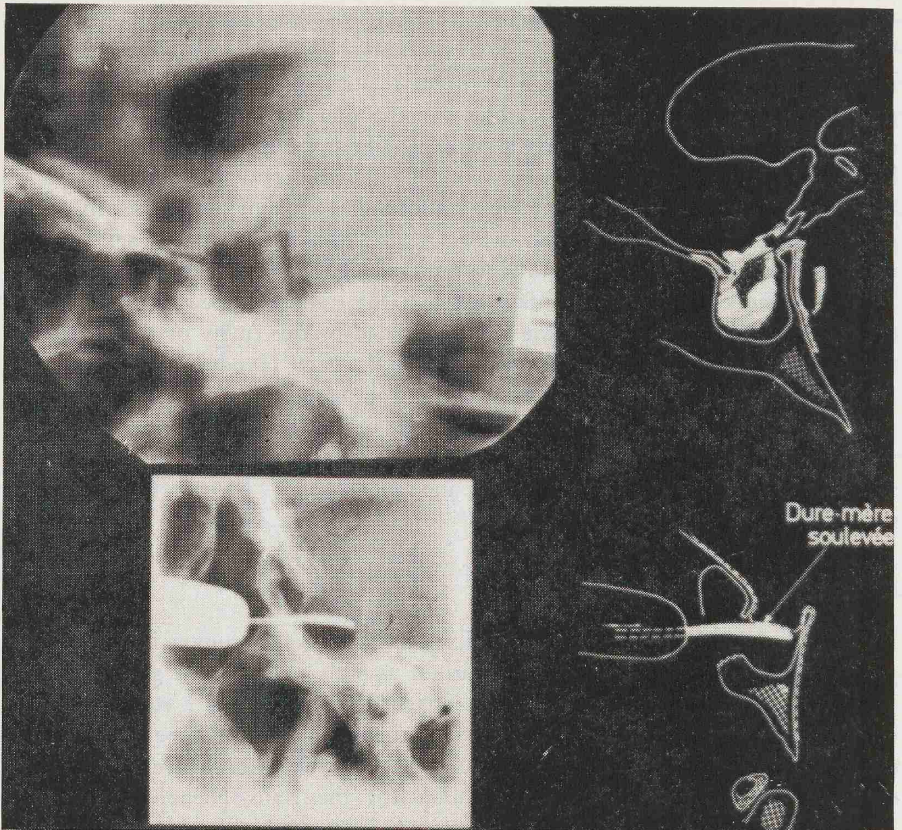


Figure 5. Empty sella revealed by a pneumo-encephalography in a female patient of 50 yrs, complaining of headaches, obesity and neuro-endocrinal troubles. On top, filling of the sella with air introduced by lumbar route, due to a probable congenital deficiency of the sellar diaphragm. On bottom, elevation of the dural floor of the sella through a transsphenoidal approach; then, extradural filling of the sella with acrylic or organic material.

*In all other cases, a craniopharyngioma can only be adequate extirpated by the intra-cranial route.*

Other types of tumors are exceptional (less than 2%): intra-sellar sub-diaphragmatic meningioma; teratoma; fibromyoma; ganglioneuroma; abscess; angioreticuloma and some other tumors which could not be classified.

There are also non-tumoral intra-sellar cysts. Such cysts may contain gelatinous, mucoid matter, xanthochromic fluid or simply, cerebrospinal fluid.

The invasion of the sella turcica and its subsequent enlargement by cerebro-spinal fluid is often due to a congenital deficiency of the sellar diaphragm. As pneumo-encephalography progresses, air replaces the intra-sellar cerebrospinal fluid; hence the radiological aspect is that of an "empty sella" (Figure 5).



### Post-operative Empty Sella

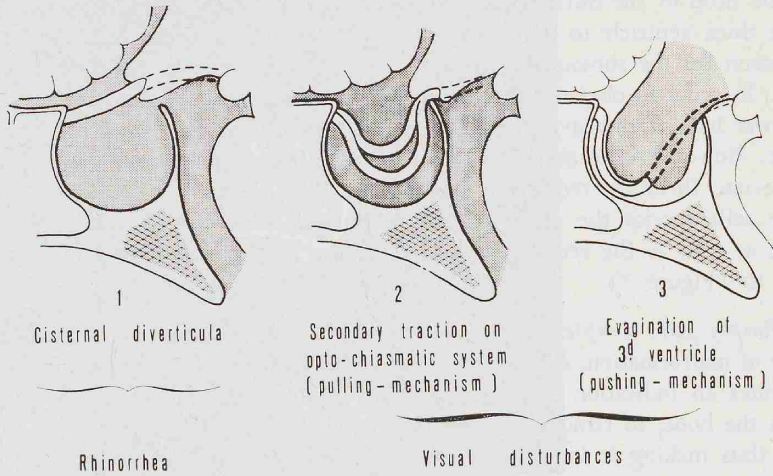


Figure 6. The three mechanisms of an empty sella following the ablation of a large pituitary adenoma.

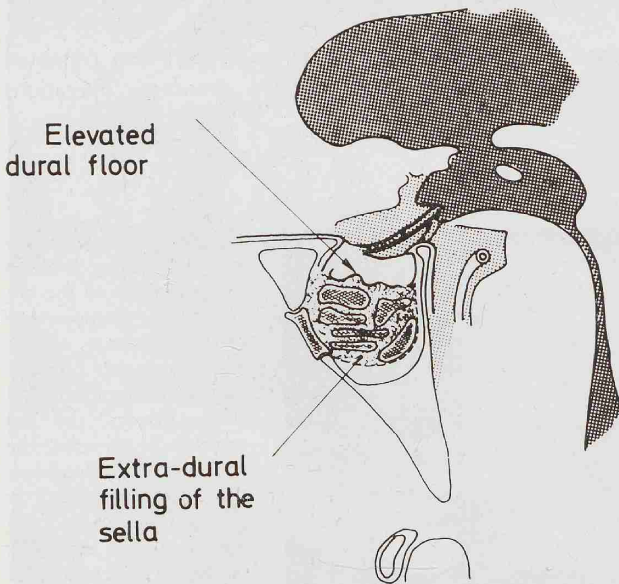


Figure 7. Diagram of the operation proposed (with D. Olson) in order to alleviate a symptomatic empty sella.

*Empty sella* may be the cause of two complications which justify the choice of a trans-sphenoidal intervention: impaired sight and rhinorrhoea.

(a) *Empty sella coupled with impaired sight.* When a pituitary adenoma is very voluminous and the sella turcica greatly enlarged and very deep, it may happen that the drop of the dural sheath carries along with it the optochiasmatic system or the third ventricle to the floor of the emptied sella (Figure 6). And that is the reason for the subsequent appearance of a new deficit of field and acuity of vision. In order to obviate this complication we have adopted the habit of filling the lower half of the cavity undergoing the operation with particles of bone and muscle. However, once these disorders had manifested themselves, it was possible to alleviate them by renewed trans-sphenoidal intervention: extra-dural filling of the sella turcica the effect of this technique being the lifting of the optic system as well as the reduction of the bending and stretching it had been subjected to (Figure 7).

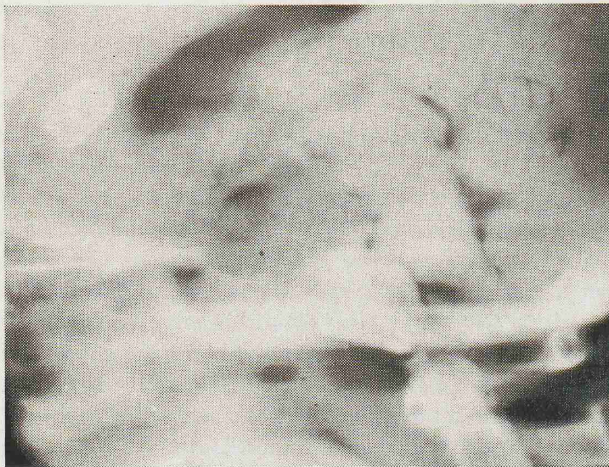
(b) *Empty sella coupled with rhinorrhea.* Empty sella and, at an additional degree of malformation, sphenoidal meningocele, may cause rhinorrhea. This again constitutes an indication for trans-sphenoidal intervention in order to close the gap in the bone, to remove the mucus from the sphenoidal sinus and to fill the latter, thus making it impervious.

#### RHINO-SEPTAL APPROACH OF SPHENOIDAL LESIONS

Many cases of sphenoidal tumor and of sphenoidal mucocele have been referred to us on account of the neurological symptoms which revealed them; or again on account of radiological changes of the sella turcica calling to mind an invasive adenoma.

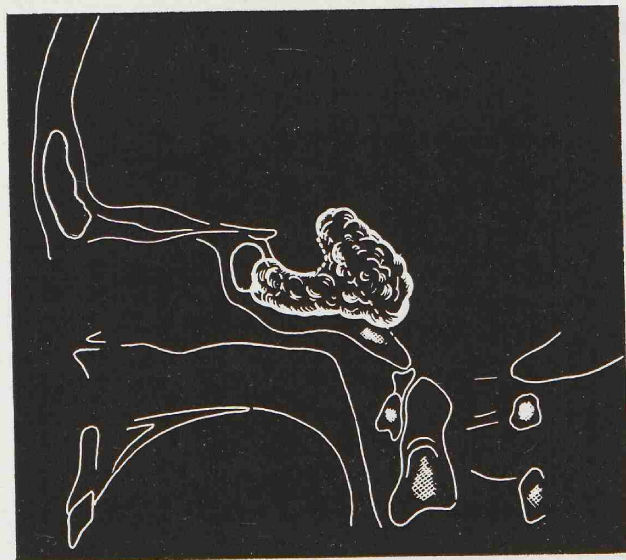
Many of these tumors proved to be malignant; for the major part they consisted of epitheliomas which have been only biopsied. Twelve *chordoma* operations

Figure 8. A chordoma of the sphenoidal clivus.

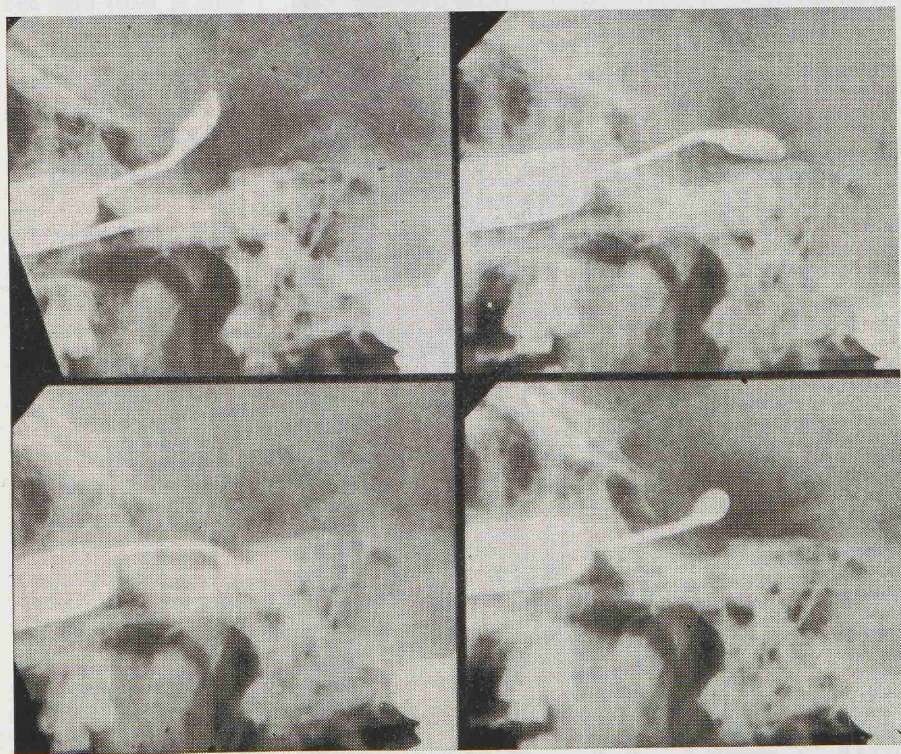


a. Preoperative tomoenkephalography. It shows the osteolysis of the clivus, the disappearance of the contours of the sella and an opacity bulging in the sphenoidal sinus. Besides, the 3rd ventricle is elevated, the aqueduct is elongated, the 4th ventricle is pushed backwards and the prepontine cistern is blocked (some islets of air are only seen within it).





b. Diagram of the tumor according to neuro-radiologic investigations.



c. The different positions of the curette during the transsphenoidal exeresis of this clivus chordoma.





d. Postoperative tomencephalography. It shows the normal contour of the sella, the 3rd and 4th ventricles at their normal position as well as a good filling of the prepontine and interpeduncular cisterns. The basilar artery is clearly seen within the basal cisterns.

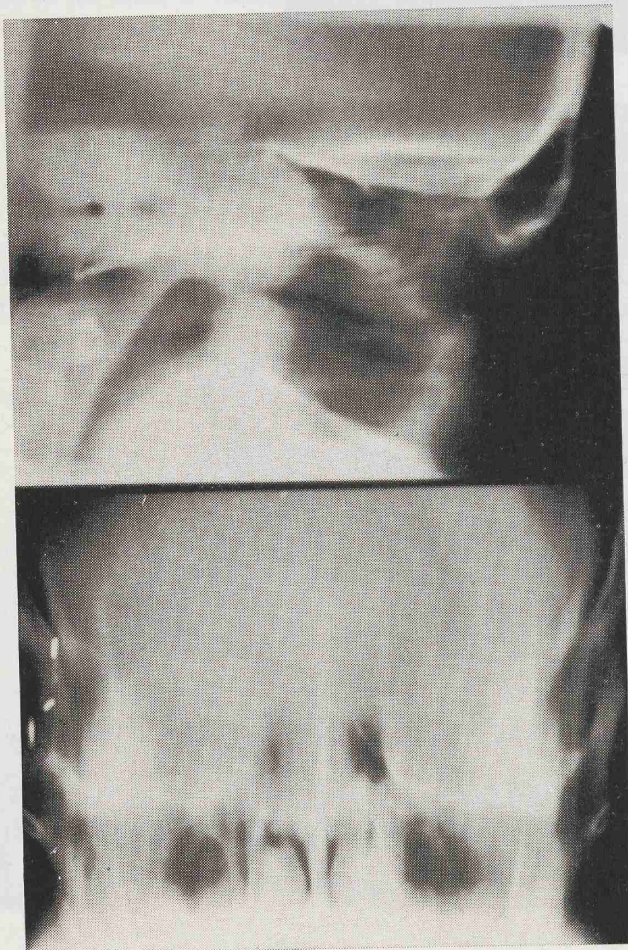
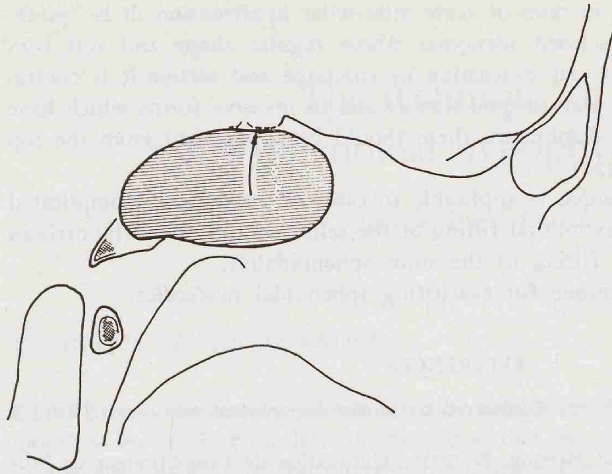


Figure 9a. A sphenoidal mucocoele on a patient suffering for many years of facial pains and relapsing opthalmoplegia. Sagittal (top) and frontal (bottom) tomographic views of the lesion. The sphenoidal sinus is largely ballooned and opaque. The sella is small and pushed upwards. The luxation upwards of the sellar content is apt to compress the opto-chiasmatic system and to provoke a falling of vision during the acute phase of high pressure within the mucocoele.





b. Diagram of the lesion in lateral view.

were performed with, in almost all cases, a history of recurrent ophthalmoplegia; this was coupled, in half of the cases, with trigeminal pain (Figure 8). The non-destructive and calcified chordomas are the most favourable type. Conversely, chordomas with concomitant osteolysis of the sphenoid and diffuse invasion constitute the most unfavourable kind: despite an apparently total exeresis and complete remission of all the symptoms, recurrences manifested themselves within a period varying from 6 months to 2 years. The only patients who survived were those who had undergone subsequent local implantation of a radio-active probe. *Sphenoidal mucocele* on the other hand gives proof of the assured success of this method of surgery. A long history of headaches, or recurrent ophthalmoplegia, facial pain and impaired vision is linked to progressive "bulging" — with acute phases of hypertension — of the blocked sphenoidal sinus. This causes lateral compression of the sinus cavernosus including the oculo-motor nerves and provokes an actual upward luxation of the intra-sellar content: hence, the optic nerves are compressed by the hypophysis itself (Figure 9). Tomography may reveal a characteristic aspect of sphenoidal mucoceles: the sinus is largely ballooned and opaque. The opening up of the sinus by the method described ensures an immediate and lasting cure of this disorder.

#### CONCLUSION

The present paper demonstrates the great variety of indications for trans-sphenoidal neurosurgery. Some authors have a much wider experience of functional hypophysectomy. Our own experience chiefly extends to pituitary adenomas in which the trans-sphenoidal approach was adopted in 89% of the cases. The indication for this technique is imperative in cases of adenomas with lower, trans-sphenoidal expansion; in elderly subjects or those whose general conditions

is frail; it is also indicated in cases of acute intra-sellar hypertension. It is "preferential" in all cases of enclosed adenomas whose regular shape and soft consistency lend themselves to easy evacuation by curettage and suction. It is contra-indicated in so-called hour-glass shaped tumors and in invasive forms which have broken through the sellar diaphragm; these should be approached from the top (by the intra-cranial method).

The trans-sphenoidal technique is applicable to cases of empty sella complicated by impairment of vision (extradural filling of the sella turcica) or by rhinorrhoea (blocking of the gap and filling of the sinus sphenoidalis).

Lastly, it is the ideal technique for evacuating sphenoidal mucoceles.

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