IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 3 Ser.4 (March. 2021), PP 18-27
www.iosrjournals.org

Endoscopic approach of the anterior cerebral fossa

K. Bouaita ,L.Atroune,T.Selmane
Neurosurgery Department , cherchell hospital.Algeria

Abstract:
Anterior skull base tumours are usually removed by a trans cranio-facial approach or an anterior trans cranial approach. The latter implies typically a retraction of the brain which could be responsible of seizures onset. Recently, the endoscopic endonasal approach for these anterior skull base tumours has been reported such as the extended endoscopic approach. The role of the endoscopic endonasal approach in the treatment of the malignant tumours of the anterior skull base has evolved. The EEN approach can be combined to a trans cranial approach in the purpose to realise a gross total resection and can be therefore be followed by radiotherapy. This endoscopic trans ethmoidal trans cribriform approach is the most rostral extension of the standard transsphenoidal approach and involves the area ranging from the anterior part of the planum to the posterior edge of the frontal sinuses. The purpose of this study is to present our experience in the endoscopic anterior skull base approach and to describe the technique.

Patients and methods: we are reporting 73 patients operated by extended endoscopic approaches (trans cribriform endoscopic approach) at Ali Ait Idir Specialized hospital in Algiers. 16 patients had fronto ethmoidal méningo-encephalocele, 04 cases had Esthesioneuroblastomas, 04 cases had ethmoidal adenocarcinomas with endocranial extension. 04 olfactory groove meningiomas and 45 dural defects of the cribriform plate

Results: in this retrospective study there were 32 women and 41 men with a mean age of 35.5 years. Anosmia was the major symptom for olfactory groove meningiomas. The other clinical symptoms were nasal obstruction, exophthalmia, difficulty breathing and epistaxis. For the dural defects the main symptom was rhinorrhea associated with meningitis in 37 patients from 45. The most frequent site of dural defect was in the ethmoidal plate which was found in 42 patients. All our patients were operated on by an endoscopic endonasal trans ethmoidal trans cribriform approach with good post-operative outcome. We used the multi layers technique for the reconstruction of the osteo dural defect. Long term follow-up revealed recurrence of rhinorrhea in 04 patients operated for osteo dural defect.

Conclusion: the endoscopic endonasal approach for the anterior skull base pathologies is considered as a satisfying therapeutic alternative due to its efficiency and simplicity

Keywords: *rhinorrhea, cribriform plate, endoscopic endonasal trans-ethmoidal trans cribriform approach, méningo-encephaloceles.*

Date of Submission: 26-02-2021 Date of Acceptance: 11-03-2021

I. Introduction :

Anterior skull base tumours are usually removed via a trans cranio-facial or anterior trans cranial approach. The latter implies brain retraction in most cases and is responsible of a risk of seizures. Skull base reconstruction is a complex and difficult procedure and can lead to a risk of CSF leak, meningitis and even skin necrosis. The endoscopic approach anteriorly to the standard trans sphenoidal approach was proposed more than a century ago. Initially, the endoscopic approaches were limited to the pituitary fossa. But with the progressive evolution of technology with the better understanding of the regional anatomy, the trans sphenoidal approach was extended to areas near sella turcica to include other pathologies in addition to sellar tumours.

Recently, the endoscopic endonasal approach for the anterior skull base approaches have been reported [2, 3, 6, 7, 9,12, 13]. The endoscopic trans ethmoidal trans-cribriform approach is the rostral extension of the standard trans sphenoidal approach which involved the area anterior to the planum sphenoidale and posteriorly to frontal sinus. The purpose of this paper is to study indications of the endoscopic approach with its limits, the operative technique according to anterior skull base tumours.

II. Patients And Methods:

We are reporting a 77 patients Serie operated at Ali Ait Idir Hospital in the period between 2010 and 2014 using extended endoscopic approaches (endoscopic trans cribriform approach) including 16 fronto ethmoidal meningo encephaloceles, 04 esthesioneuroblastomas, 04 ethmoidal adenocarcinomas wirth endocranial involvement, 04 olfactory groove meningiomas and 03 other types of tumours (recurrence of an orbital roof meningiomas, naso pharyngeal fibroma and ethmoido orbital osteoma). 45 osteo dural defects

involving the ethmoidal plate were operated in our Serie which consists of a retrospective study of 34 women and 43 men with a mean age of 35.5 years. Anosmia was the major symptom for olfactory groove meningiomas followed by seizures.

The main symptom for osteo meningeal defects was rhinorrhea with meningitis in 37 patients. The most frequent location of CSF leak was the ethmoid plate that was found in 42 patients from a total of 45. The other clinical symptoms were nasal obstruction, xerophthalmy, difficulty breathing and epistaxis. All our patients were operated by an endoscopic endonasal trans ethmoidal trans cribriform approach. The overall post-operative outcome was good.

All our patients were operated by an endoscopic endonasal trans cribriform approach

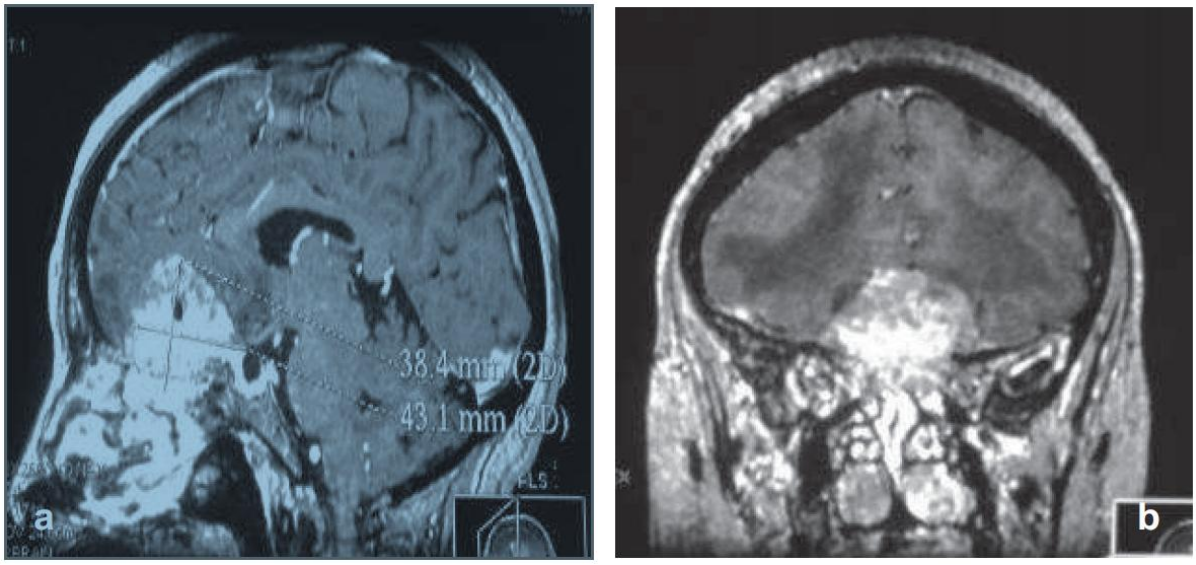


Figure1: preoperative MRI, (a) sagittal view, (b) frontal view showing an olfactory groove meningioma with involvement of the ethmoidal plate and the posterior ethmoid

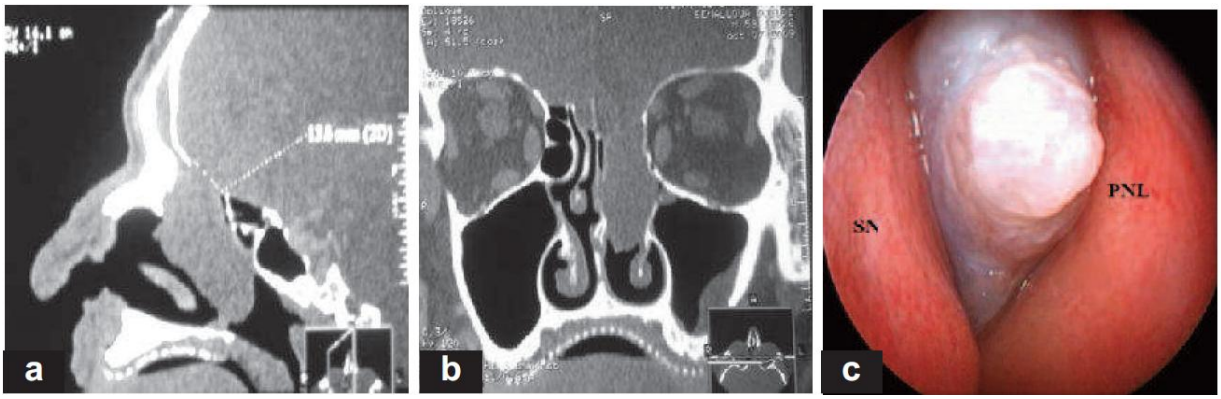


Figure 2: Preoperative CT scan with sagittal reconstruction (a) frontal reconstruction (b) showing a left fronto ethmoidal meningo encephalocele. Endoscopic view of the lesion (c).

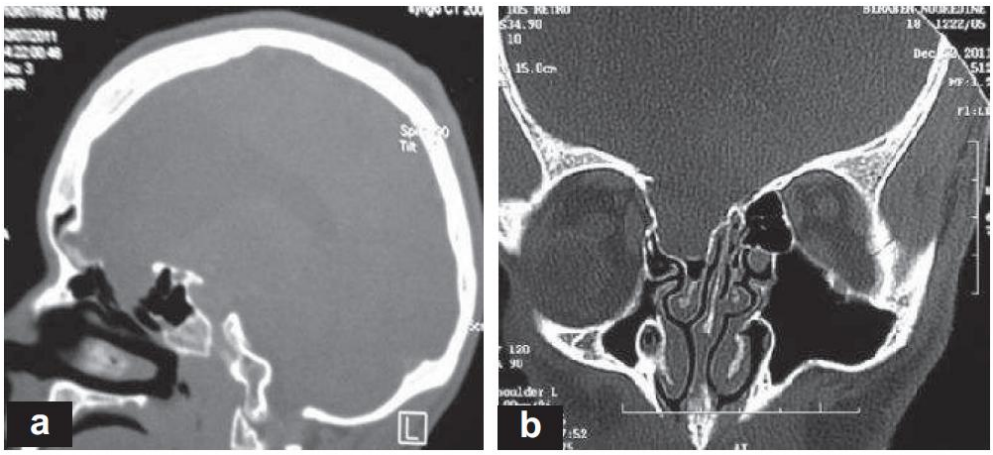


Figure 3: Preoperative CT scan with sagittal (a) and frontal (b) reconstruction showing a right fronto ethmoidal méningo-encephalocele.

III. Surgical technique:

We are describing the endoscopic trans-cribriform approach applied to olfactory groove meningiomas.

1. Preparation:

This approach is the rostral extension of the standard trans sphenoidal approach. It is limited anteriorly by the frontal sinus and posteriorly by the planum sphenoidale and laterally by the inner wall of the orbit. The gyrus rectus with the orbito frontal gyrus are located superiorly which are easily exposed bilaterally showing olfactory nerves on each side. The surgical procedure is particularly difficult and needs meticulous preoperative preparation of the patient as well as the material for skull base reconstruction after the tumour removal (fibrin glue, synthetic dura)

The patient is operated under general anaesthesia with cardiac monitoring. Oropharynx packing was used to avoid inhalation of blood. Patient is placed supine with trunk elevated by 20° to reduce venous bleeding. The head is tilted slightly toward the surgeon and the neck is in extension by 30° to help exposition of the anterior sub frontal area. The antero lateral part of the thigh is prepared for excision of the muscular aponeurosis to use as auto graft for the skull base reconstruction.

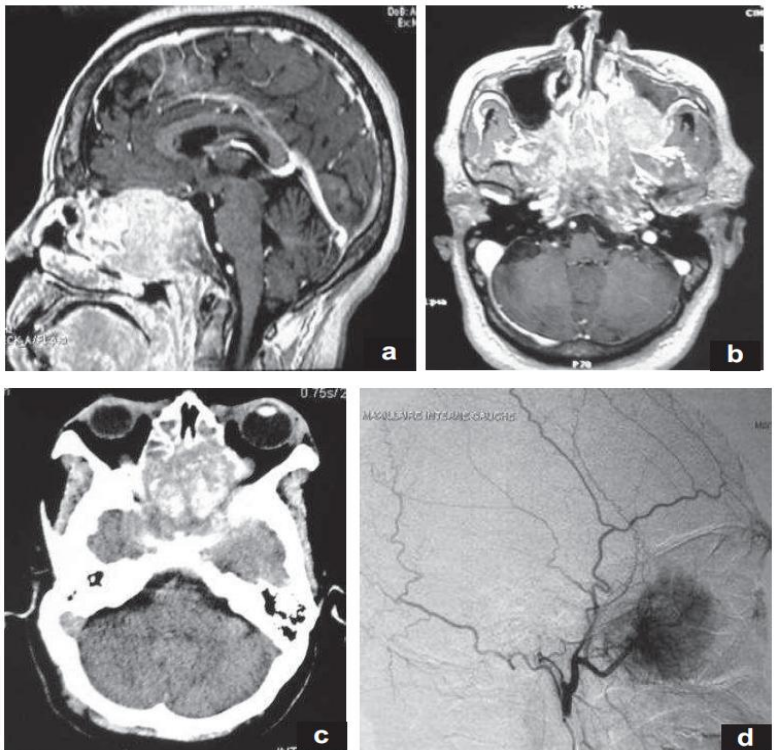


Figure 4: preoperative cerebral MRI in sagittal (a) and axial (b) and CT scan (c) showing an ethmoidal carcinoma (d) Arteriography showing vascularisation of the tumour

2. Nasal cavities disinfection:

Cottonoid soaked in Betadine solution are used for disinfection and decongestion of nasal cavities and are inserted alongside of the nasal cavities floor as well as the space between the nasal septum and the middle turbinate. After that we disinfect the skin around the nose and the front. Long cottoinoids soaked in the chlor hexidine gluconates 5% are then inserted in the space between the nasal septum and the middle turbinate to take an effect of vasoconstriction of nasal mucosa blood vessels after few minutes. The surgical procedure is then carried out through two main steps.

a. **Naso-sinusal phase**, called also the extra dural exposition

Under an endoscopic view of a hard 0° endoscope (18 cm long and 4 mm in diameter) the inferior, middle and superior turbinate are first identified. The endoscope is then pushed forward to the choana then to the middle and superior turbinate. The Middle turbinate are then resected bilaterally after coagulation of their base by the Monopolar cautery. The cartilaginous nasal septum and its mucosa as well as the superior third of the septal attachment with the roof of the nasal cavities. This procedure can alter olfaction but this can be already impaired by the lesion.

The endoscope already placed in the nostril where instruments are introduced through the other nostril or in both. The procedure is continued by the incision of the uncinate process with the scalpel parallel to the orbital plate to avoid breaching the orbit (figure 5) the incision is carried out laterally and down to the maxillary sinus ostium.

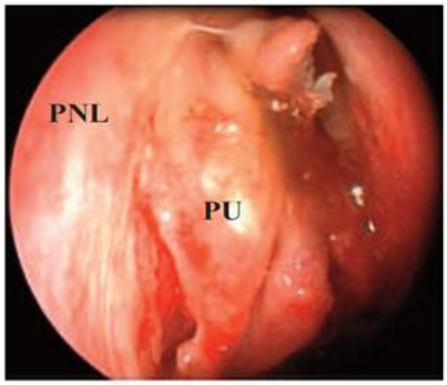


Figure 5: endoscopic view of the incision and resection of the uncinate process
PNL: lateral nasal wall, PU: uncinate process

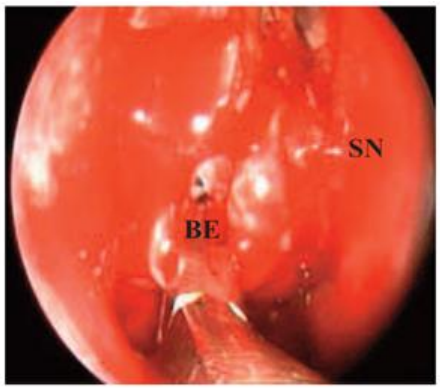


Figure 6: endoscopic view of the anterior resection of the ethmoid bulla
BE: ethmoid bulla, SN: nasal septum

The uncinate process is then resected from its anterior attachment (figure 6) which let expose the anterior part of the ethmoid bulla

The anterior ethmoidal cells are then opened bilaterally, the basal lamella of the middle turbinate is then resected to expose the posterior ethmoidal cells to achievea complete ethmoidectomy (figure 7) the latter is followed by the exposition of the orbital plate.

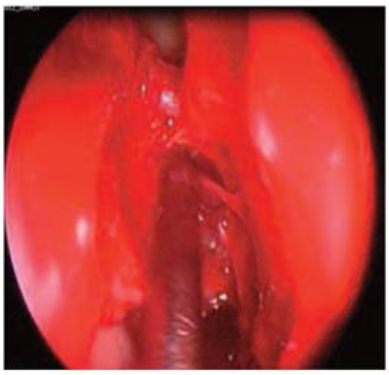


Figure 7: endoscopic view of the frontal recess with a total right ethmoidectomy
The frontal recess is exposed anteriorly with a complete resection of Agger Nasi cells to achieve a large exposition of the skull base (figure 8)

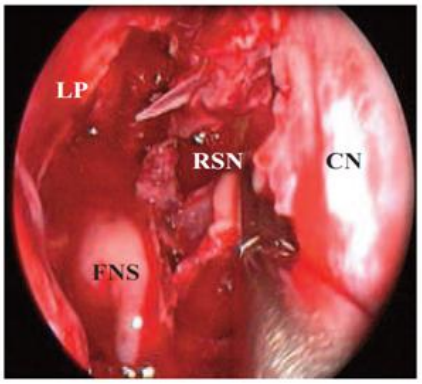


Figure 8: endoscopic view of nasal septum resection offering a bilateral access to the skull base (CS: septal cartilage, LP: orbital plate, RSN: nasal septum resection, FNS: Naso septal flap)

To achieve a proper devascularization of the tumour, the anterior ethmoidal artery is identified and coagulated with bipolar cautery at the junction of the naso-frontal recess and the roof of ethmoidal sinus. The posterior ethmoidal artery which is located at the junction between sphenoidal sinus and the posterior ethmoidal cells is also coagulated.

The cribriform plate is exposed and appear to be infiltrated by the tumour, it is resected bilaterally using Kerrisson and a high-speed drill. Drilling starts at the posterior part of the fronto ethmoidal recess and is continued posteriorly to the sphenoid sinus in a rostro caudal direction. The lateral extension of the drilling is limited between Fovea ethmoidalis and the orbital plate. The Crista Galli process is drilled and reduced to a thin layer, then it is fractured and resected with a small bone forceps. At this stage, a unique large cavity is obtained at the anterior skull base. In the first case, there was a posterior extension of the tumour to the planum which was at the origin of the sphenoid sinus opening and the resection of the planum sphenoidale.

b. The intra cranial phase:

Starts with the dura opening on each side of the falx but in the first case, dura was already invaded by the tumour and it was breached after the ethmoid plate resection. Dissection and resection of the lesion in this location follow the rules of microsurgery dissection and the use of adequate instruments and specific bipolar. the tumour resection is achieved in three major steps: devascularisation of the tumour and debulking, dissection and resection of the capsule and the reconstruction of the skull base.

Devascularization of the tumour:

The coagulation of the anterior and posterior ethmoidal arteries helps to devascularize the tumour. coagulation of the dura before its opening helps a further control of the tumoral vascularization. Therefore, the initial tumour devascularization constitute the major advantage of this endoscopic approach. The anterior artery of the falx supplies the tumour with few pial vascularization distal branches of the anterior Polygon of Willis.

Debulking:

Consists of an intra capsular tumour resection using the CAVITRON (a specific aspiration tip for the endonasal approach) depending on the tumour consistency until both sides of the falx are visualized.

Blood supply of the tumour provides from the anterior artery of the falx which can be identified at the edge of the falx on each side. These vessels can be coagulated and sectioned along the falx, then the latter is sectioned to obtain a unique intra dural cavity. The anterior dura is left intact to prevent hernia of the brain in the operating filed.

The intra capsular removal of the tumour is continued to let a thin capsule to be dissected from the cortex from the cortex and the anterior artery branches of polygone of Willis.

Extra capsular Dissection*:*

This step is particularly difficult and should be carried with caution and meticulous fashion. The tumour capsule is very thin and can be fold and retracted after the intra tumoral debulking. The slight tension on the capsule can help a achieve a convenient extra capsular dissection using spatula and cottonoids starting from the inter hemispheric fissure. Then the dissection is carried out in the anterior pole of the tumour in contact with the gyrus rectus. After that, the capsule is freed from the postero superior poles where the fronto polar and A2 segment of the anterior cerebral artery can be in contact with the capsule and should be dissected with caution. After the total removal of the capsule, the cavity is inspected for any residual tumour (figure 10). Hemostasis is then obtained and the cerebral cortex is protected by Surgicel.

Figure 9: endoscopic view of the tumour resection usin

g Cavitron CT: tumour capsule, MG: meningioma, CV: cavitron

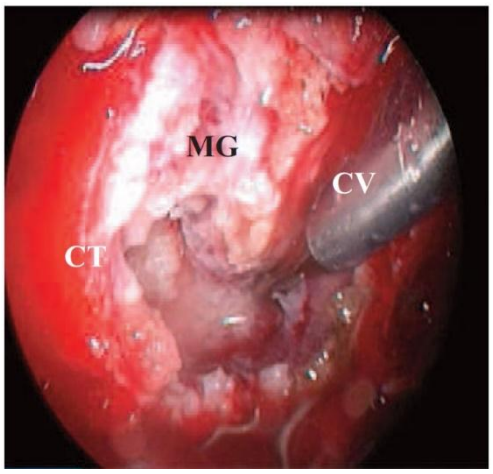
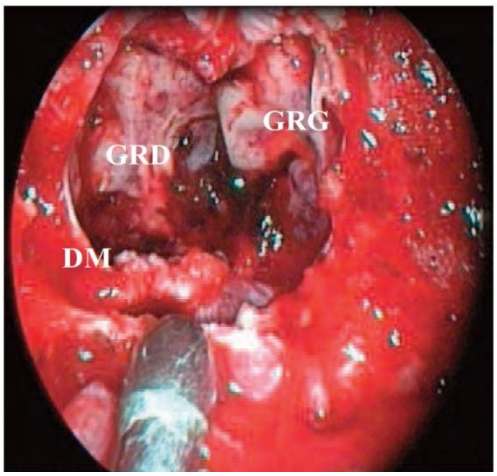


Figure 10: endoscopic view of gyrus rectus after complete resection of the meningioma GRD: right gyrus rectus, GRG: left gyrus rectus, DM: dura



Closure:

depending on the size of the dural opening, the reconstruction of the osteo dural defect is achieved at the end of the procedure to realise a water tight closure. The anterior floor of the skull base is closed in a multilayer fashion using fibrin glue and a small balloon to keep the reconstruction in place. The first layer is taken from fascia lata of the antero lateral side of the patient's thigh which is inserted intra durally before it is covered by fibrin glue. After that the second layer of fascia lata is applied with the bony tissue of the middle concha removed during surgery. The total reconstruction is then covered with fat and surgical and kept in place with the help of a small balloon (12 ml of physiological serum) inserted in the nasal cavity and kept for 5 days. The Valsalva manoeuvre is used to check for any CSF leak at the end of the procedure.

IV. Results:

Immediate Post-operative outcome was good without any complications nor CSF fistula. The inserted nasal balloon was removed in the 5th day with the mean hospital stay for our patients was 7 days. The extent of the tumour removal is summarized in table 1.

Type of the tumour	*Number*	*Extent of the tumour removal*
Olfactory groove meningiomas	05	Total (100%)
Tuberculum sellae meningiomas	02	Total (100%)
Ethmoidal adenocarcinomas	04	Subtotal (90%)
Meningioma of the orbital roof (recurrence)	01	Total
Naso pharyngeal fibroma	01	Total
Esthesioneuroblastoma	01	Partial
Ethmoido orbital osteoma	01	subtotal

Table 1: surgical removal quality of the anterior skull base tumours

V. Discussion

The anterior skull base tumours can be operated on by an extended endoscopic approach. The trans cribriform approach can be applied to tumours arising in an area limited by the frontal sinus anteriorly and planum sphenoidale posteriorly with the orbital plate on each side below the orbito frontal gyri and the gyrus rectus which are easily exposed with the olfactory tract bilaterally.

The trans ethmoidal endoscopic approach is realised bilaterally or even unilaterally depending on the volume of the lesion. Thus, the unilateral approach is reserved to meningo encephalocele, meningoceles and CSF leak whereas the bilateral approach is indicated for benign or malignant tumours of the anterior skull base except for the tuberculum sellae meningiomas [2, 3, 6, 7]. This approach is then used for olfactory groove meningiomas, esthesioneuroblastoma, squamous cells carcinomas, juvenile angiofibroma. The choice to adopt a more medial or lateral related to the middle concha depends on the location of the lesion, its size and its lateral extension.

The middle concha resection bilaterally is the rule for many authors regardless of tumour size. But for others (especially forsamll sized olfactory groove meningiomas) the trans nasal trans cribriform approach with the preservation of one or each middle concha was reported in the literature. A large opening of ethmoidal sinus is achieved for an adequate exposition.

Indications :

a. Olfactory groove meningiomas and the meningo encephalocele: are benign lesions that represent the best choice of the this approach as it offers a direct access to the dural attachment of the meningioma which is vascularised by ethmoidal arteries[14]. In addition to that, this approach offers not only the tumour removal but also the dural attachment and the bony hyperostosis invaded by the tumour.

b. Fronto-ethmoidal meningo-encephalocele: which are common lesions of this region whether they are spontaneous or post traumatic.

c. Osteo meningeal defect of the anterior skull base: which can be post traumatic or spontaneous presenting with rhinorrea with recurrent meningitis.

d. Other malignant tumours :

Esthesioneuroblastomas or olfactory neuroblastoma arise from olfactory epitheliomas [2, 3, 9, 10, 13], whereas the juvenile neurofibroma and the squamous cells carcinoma arise from the sinus. In spite that these tumours are usually unilateral, they can invade rapidly the cribriform plate into the anterior cranial fossa and the contro lateral fossa. The role of endoscopic endonasal approach in the treatment of these tumours has evolved and can be combined to trans cranial approaches in the purpose to realise a total resection with the use of complementary radiotherapy.

Contre indications:

Tumours with an important lateral extension can be operated by trans cranial resection. Because the distance between the orbital plate and the crista Galli process is around 22± 04mm [6]. The decision to operate these tumours through a minimally invasive endonasal approach should be done with the contribution of oncologists, neurosurgeons and ENT surgeons. Afterall, te final decision can vary from a team to another.

Morbidity – Mortality:

The recent introduction of the endoscopic endonasal approach in the surgery of the pituitary region has been extended to be used in the surgery of the anterior cerebral fossa and contributed to reduce significantly post-operative morbidity and mortality related to surgery of olfactory groove meningiomas. According to many small series in the literature, the potential role of the endoscopic resection of the anterior skull base tumours and particularly olfactory groove meningiomas has not been clearly defined, and until this date, no critical clinical evaluation in the literature has been established according to its efficiency. For the other few larger series, authors focused on the operative techniques and their results. But they did not provide results of their work on long term follow up. Many series published a follow up length of 6 to 24 months [1, 2, 3, 6, 7, 9, 12]. Therefore, no conclusion can be taken according to the efficiency of the therapeutic strategy. The most important complication of the skull base endoscopic approach (particularly the olfactory groove meningiomas) is the CSF leak. The high rate of this complication can be related to the large osteo dural defect which extend from the posterior aspect of the frontal sinus to the planum sphenoidale. The rate of CSF fistula is 32% (0 – 40% according to many series) [1]. Gardner and co reported 04 cases of CSF fistula (26.7%) among 15 patients [1, 12]. De Divittis and co had one case of CSF fistula from 047 cases operated by an endoscopic approach (25%).

Quality of the resection:

Majority of authors agree that the resection quality is similar between the trans cranial approach and the endoscopic approach (total resection rate is 86.4% for the endoscopic trans nasal approach versus 83.3% for classic surgery). Although the resection rate was reported as total in some endoscopic series, but they were not graded according to the Simpson System which makes the comparison more difficult [12, 16, 17, 18].Gardner & co reported in one recent serie 83% of total and subtotal resection rate (10 cases among 12 operated olfactory groove meningiomas) with a CSF leak rate of 2.7%. De Divittis & co reported a total resection rateof 100 % in 04 patients with CSF leak in 25% which represent one patient (table 2) [1, 7].

Authors	*Number*	*Olfactory groove meningioma*	*Tuberculum sellae meningiomas*	*Years*	*CSF fistula*
Fatemi & al	14	00	14	200 – 2008	29% (04 cases)
Wang & al	07	00	07	2002 – 2005	14% (01case)
Gardner & al	28	15	13	2002 – 2005	43% (12 cases)
De Divittis & al	11	04	07	2004 – 2007	27% (03 cases)
Dehdashti & al 2009	01	01	01	- -	100%
Cook & al 2004	03	00	03	– -	00
Laufer & al 2007	05	00	05	– -	20% (1 case)
Jamie & al	13	00	13	2003 – 2010	00
Our serie	10	07	03	2009 – 2014	02 cases

Table 2: Series of anterior skull base meningiomas operated by and endoscopic trans nasal approach as described by Jamie.

Authors & years	*Number of cases*	*Resection quality (%)*		*Morbidity (%)*		*Prognosis (%)*			*Mortality*
		RT	RST	CSF fistula	D.I	Improvement	Worsening	Inchanged	
De Divittis 2007	06 cases	83.3	16.70	16.70	16.70	83.3	16.7		16.7 % (01 case)
Laufer & al 2007	05 cases	100		20	20	100			
Wang & al 2010	12 cases	91.6	8.40			92		8	
James & al 2011	13 cases	53.84	46.15			38.46		30.76	7.69% (1case)
Our serie 2015	03	100		33	33	100			00

Table 03: results of different series of tuberculum sellae meningiomas operated by endoscopic trans planum approach

Jamie & co reported an analysis a retrospective study in the literature where 69 meningiomas of the anterior cerebral fossa from which 50 were tuberculum sellae meningiomas. Total resection was achieved in 76% of cases with 12% of subtotal resection. CSF leak was reported in 34% of cases table 3 [17]. Table 2 summarises results of tuberculum sellae meningiomas surgery in the few recent series if the literature (table 3)

In a serie of esthesioneuroblastomas published by Gallia & al in 2011, 08 cases were operated on between 2005 – 2010 where 06 tumours were found to be primitives and 02 were recurrences [11]. Total resection was complete in 06 patients (89.4%) without post-operative complications. Survival length was 27 months. Certain authors found that the survival rate after 5 years went up by 10 – 15% when radiotherapy is combined with surgery.

Tumour recurrence:

The olfactory groove meningiomas tend to extend into the nasal cavity and ethmoid sinuses in 15% of cases. Simpson 1 total resection includes the removal of dural attachment, infiltrated bone and the hyperostosis in the cribriform plate to prevent tumour recurrence. However, many surgeons prefer a more conservative approach with Simpson II removal rate without addressing the hyperostosis of the cribriform plate to avoid breaching of the paranasal sinuses due to the higher risk of post-operative CSF leak.

The rate of olfactory groove meningiomas recurrence is as high as 30% after 5 years and 41% after 10 years due to the incomplete resection of the tumour. the ethmoidal sinuses and the cribriform plate are the main sites of recurrences when the tumour invades the paranasal sinus and the nasal cavity. Derome & Giout reported 15% of olfactory groove meningiomas with extension into the paranasal sinuses.

Spektor & al reported 26.3% of paranasal sinuses invasion in 81 patients serie [1]. Al Mefty concluded that in his serie that all patients who presented recurrences of olfactory groove meningiomas had hyperostosis of the anterior skull base. The advantage of the endoscopic approach is the removal of the tumour starting from the nasal cavity then the para nasal sinuses before the removal of the hyperostosis of the cribriform plate followed by the dural attachment achieving a Simpson 1 resection grade to avoid recurrence [15, 16, 17, 18, 19].

Osteo dural fistula of the cribriform plate represent 54.5% of cases in our serie. Their clinical diagnosis is made after evidence of rhinorrhea with episodes of recurrent meningitis. This clinical finding was confirmed in all our patients. On the other hand, rhinorrhea was found in 64% in the literature with 10% of meningitis. Headaches were found in 08%. The most frequent origin of osteo dural defect in our serie was the post traumatic origin with 55% with one case presented with iatrogenic origin in accordance with the literature [5, 20].

CT Scan in coronal and sagittal slides is our investigation of choice to determine the exact location of the dural defect. MRI was rarely performed in the opposite of the radioactive isotopes which was realised in 100% of patients of our serie. The most frequent location of CSF fistulae is the cribriform plate of the ethmoid. The rate of the post traumatic origin of CSF fistulae varies between series. The endoscopic repair remains the best option for osteo dural defects according to its location in the skull base. The cribriform plate was highly involved in our serie , for that we used the endoscopic endonasal trans ethmoidal trans cribriform in all our patients with only one trans ethmoidal approach for a iatrogenic fistula. In the published serie of David Locatelli & al the endoscopic trans cribriform approach was used in 50% of cases whereas the trans ethmoidal approach involved 35% of cases [5].

The use of fluorosceine per operatively to determine and locate precisely the location of the fistula was reported by many authors in the literature. We sis not use the Fluorosceine in our serie.

For the reconstruction of the osteo dural defect, we used the Multilayers technique as described by Kassem & al. The underlay technique was particularly used in the reconstruction of the cribriform plate. All authors agree to use fibrin glue with a stent balloon to maintain the reconstruction in place. In the lack of stent balloon, we used a Folley balloon of a urinary catheter. To Close the dural defect, we used the fascia lata, middle chonca mucusa and bone, septal cartilage, bone of the perpendicular plate of the ethmoid, abdominal fat and synthetic dura like the majority of authors. While others, sutured the dural defect with a U-shaped clip used in vascular anastomosis, temporal muscle aponeurosis, silastic implants, titanium plates and Floseal. The naso septal flap of Haddad was used in all our cases. The Global Morbidity reported in the literature is very low in the majority of series except for some minor rhinologic complications like nasal synechia, nasal crust that we have observed in our serie [5,20].

Results that we have collected in our serie are satisfying, 04 cases from 54 that we have operated presented with recurrence after a post-operative period varying from 6 months to 01 year. One case of a young woman who was reoperated by a trans cranial approach for recurrence of CSF leak after meningo encephalocele operated first endoscopically. Two other patients were reoperated by an endoscopic approach with a 100% success rate after the second operation. In the literature, the success rate of the endoscopic approach is 83 – 95% after the first operation and 86 – 100% after reoperation. In our serie the success rate was 92% of cases.

VI. Conclusion:

The endoscopic endonasal approach has taken an indisputable place in the surgical treatment of lesions of the anterior skull base. It is a minimally invasive surgery with few morbidities when compared to trans cranial which makes it prone to be more popularized.

Bibliography

[1]. amin b. Kassam, m.d.,1,2 daniel m. Prevedello, m.d.,1ricardo l. Carrau, m.d.,1,2 carl h. Snyderman, m.d.,1,2 ajith thomas, m.d.,1 paul gardner, m.d.,1 ada m Zanation, m.d.,2 bulent duz, m.d.,3 s. Tonya stefko, m.d.,1,4 karin byers, m.d.,5 and micha el b. Horowitz, m.d.1: endoscopic endonasal skull base surgery: analysis of complications in the authors' initial 800 patients a review.j neurosurg 114: 2011.1544–1568.

[2]. castelnuovo p, bignami m, delù g, battaglia p, bignardi m, dallan i: endonasal Endoscopic resection and radio therapy in olfactory neuroblastoma: our experience. Head neck. 2007

[3]. Sep; 29 (9): 845-50. 3] ceylan s, koc k, anik i: Extended endoscopic approaches for midline skull-base lesions. Neurosurg rev. 2009 jul; 32 (3): 309-19.

[4]. darlene lubbe, patrick semple, johan fagan: advances in endoscopic sinonasal and anterior skull base surgery. August 2008, vol. 98, no. 8 samj

[5]. davide locatelli, m.d. federic orampa, m.d. ilariaacchiardi, m.d. francesca de bernardi, m.d. endoscopic endonasal approaches

[6]. For repair of cerebrospinal fluid leaks: nine-year experience. Jns- 246 - vol 58 – operative neurosurgery 2 - april 2006. 6] dehdashti ar, ganna a, Witterick i, gentili f: expanded endoscopic endonasal approach for anterior cranial base and suprasellar lesions: indications and limitations.neurosurgery. 2009 apr; 64 (4): 677-87.

[7]. enrico de divitiis, felice esposito, paolo cappabianca, luigi maria cavallo: endoscopic endonasal resection of anterior cranial fossa meningiomas. Neurosurg. Focus /vol25/ dec. 2008.

[8]. Enrico De Divitiis, Felice Esposito, Paolo Cappabianca, Luigi Maria Cavallo, Oreste L'approche Endoscopique De La Fosse Cerebrale Anterieure 25 De Divitis : Endoscopic Endonasal resection of midline cranial base Tumors. JBNC19 (2):7-17, 2008

[9]. Fernandez-Miranda Jc, Gardner Pa, Prevedello Dm, Kassam A: Expanded endonasal approach for olfactory groove meningioma. Acta Neurochir (Wien). 2009 Mar; 151(3):287-8.

[10]. Folbe A, Herzallah I, Duvvuri U, Bublik M, Sargi Z, Snyderman Ch, Carrau R, Casiano R, Kassam Ab, Morcos JJ: Endoscopic endonasal resection of esthesioneuroblastoma: a multicenter study.Am J Rhinol Allergy. 2009 Jan-Feb; 23(1):91-4.

[11]. Gallia Gl, Reh Dd, Salmasi V, Blitz Am, Koch W, Ishii M: Endonasal endoscopic resection of esthesioneuroblastoma: the Johns Hopkins Hospital experience and review of the literature.Neurosurg Rev. 2011 Jun 8.

[12]. gardner pa, kassam ab, thomas a, snyderman ch, carrau rl, mintz ah, prevedello dm: Endoscopic endonasal resection of anterior cranial base meningiomas. Neurosurgery. 2008 Jul; 63 (1): 36- 52; discussion 52-4.

[13]. Greenfield Jp, Anand Vk, Kacker A, Seibert Mj, Singh A, Brown Sm, Schwartz Th: endonasal transethmoidal trans cribriform trans fovea ethmoidalis approach to the anterior cranial fossa and skull base. Neurosurgery. 2010 May; 66 (5): 883-92.

[14]. gurston g. nyquist, m.d., 1 vijay k. anand, m.d., 1 saral mehra, m.d., m.b.a., 1ashuto shkacker, m.d., 1: Endoscopic endonasal repair of anterior skull base non-traumatic cerebro spinal fluid leaks, meningoceles, and encephaloceles J. Neurosurg. 2010. 113: 961-966.

[15]. Hilal a. Kanaan, m.d.,1 Paul a. gardner, m.d.,1 gabriel leyeaney, m.d.,2 daniel m. prevedello, m.d.,1 edward a. monaco iii, m.d., ph.d.,1 geoffrey murdoch, m.d.,2 ian f. pollack, m.d.,1 and amin b. kassam, m.d.1: expanded endoscopic endonasal resection of an olfactory schwannoma case report. J. Neurosurg pediatrics 2008. 2 :261-265.
[16]. james k. liu, m.d.,1,2 lana d. christiano, m.d.,1 smruti k. patel, b.a.,1 r. shane tubbs, m.s., p.a.-c., ph.d.,3 andjean anderson eloy, m.d.2: Surgical nuances for removal of olfactory groove meningiomas using the endoscopic endonasal transcribriform approach. Neurosurg Focus 30 (5):2011. E3.
[17]. jamie j. van gompel, m.d.,1 giorgio frank, m.d.,2 ernesto pasquini, m.d.,2 matteo zoli, m.d.,2 jason hoover, m.d.,1 and giuseppe lanzino, m.d.1: Expanded endonasal endoscopic resection of anterior fossa meningiomas: report of 13 cases and meta-analysis of the literature. Neurosurg Focus 30 .2011. (5): E15.
[18]. jho hd, ha HG:Endoscopic endonasal skull base surgery: Part 1-The midline anterior fossa skull base. Minim Invasive Neurosurg. 2004 Feb; 47(1):16-23.
[19]. parsons jt, mendenhall wm, mancuso aa, : Malignant tumors of the nasal cavity and ethmoid and sphenoid sinuses. Int J Radiat Onc Biol Phys 14:1-22, 1988. khirim n nburdenko: Extended endoscopic endonasal transsphenoidal approaches in skull base surgery. 2008 Oct-Dec ;(4) : 47-9; Russian.
[20]. schmerber s, righini c, lavielle jp, passagia jg, reyte : Endonasal endoscopic closure of cerebrospinal fluid rhinorrhea. Skull Base. 2001 Feb; 11(1):47-58.

K. Bouaita, et. al. "Endoscopic approach of the anterior cerebral fossa." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(03), 2021, pp. 18-27.