

## The Role of Endoscopy in the Surgery of Cerebrospinal Rhinorrhea in Children.

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**Abstract:** The main objective of this study is to show our experience and the interest of endoscopic surgery and especially the multilayer technique in the treatment of post-traumatic osteo-dural defects in the roof of the ethmoid bone in the pediatric population. 35 of children, 13 girls / 22 boys, mean age 8 years old (range from 02-15 years) with post-traumatic cerebrospinal rhinorrhea, radiological exploration including multiplanar scanner. These children were operated in 2011-2015 by an endoscopic approach with the multilayers technique. A long-term follow-up ranges from 12 to 52 months. The major symptom is unilateral rhinorrhea in all patients (100%), Repeated Meningitis was observed in 15 children (42.8%) In 04 children (11, 4%) we found a defect associated with small meningoceles without cerebral hernia while in 8 patients (22, 8%) it was a meningo-encephalocele associated with osteo-dural defect more or less wide. The hospital stay varies between 7 to 10 days after removal of the ball on the fifth day. After a long follow-up of 12-60 months, we have reoperated three cases of osteo-dural defects the results is 100% successful. Minimally invasive techniques continue to evolve with low morbidity and a success rate close to 90%.

**Keywords:** endoscopy, ethmoid roof, morbidity, multilayer, , rhinorrhea,

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### I. Introduction

The presence of CSF rhinorrhea implies a breach of the skull base with opening all the barriers that separate the subarachnoid spaces of the upper aerodigestive tract. The finding of cerebrospinal rhinorrhea demonstrates the existence of a CSF leakage, the CSF leakage is defined as a communication between the subarachnoid space and the nose resulting from a bone defect, a tear of the dura and arachnoid in addition to a pressure gradient. The origin of the defect of the skull base in children can be congenital (meningoencephalocele) or post-traumatic (skull base fracture). Meningoencephalocele in children is rare, its incidence is 1: 5000 birth. The post-traumatic rhinorrhea is less common than in adults and accounts for about 0.2 to 0.3% of brain injuries in children. This may be explained by a better flexibility of the bones of the skull that absorbs the traumatic shock wave (1-2). Rhinorrhea is the major symptom, associated with repeated meningitis in children with post traumatic osteo - dural defects. Its diagnosis is clinical, biological and radiologic. The place of transferrin B2 and B-trace is essential to identify cerebrospinal fluid. The goal of radiology is to confirm the existence of the CSF leakage, accurately indicate its location and if possible the cause, in a minimally invasive manner (3-4). The management of CSF fistula is controversial, the goal of surgery is to repair the breach to prevent the flow of CSF. Repair by endoscopic endonasal approach took 20 years to replace external approaches especially neurosurgical, achieving success rate of 85- 90% in almost all published series (5-6-7-8-9-10-11). In this article, we report our experience with endoscopic treatment with the technique of thousand or multilayer sheets used for repairing osteo - dural defects at the base of post-traumatic skull in 35 children.

### II. Patients And Methodes

This is a retrospective study of 35 children operated by endonasal endoscopic approach for osteo - dural defects at the base of the skull in AliAitIdir hospital, Algiers over a period from 2011-2015 by the same surgeon.

**2-1-diagnosis and preoperative evaluation:** All patients had a clinical history marked by the appearance of a unilateral rhinorrhea in most cases or repeated meningitis and once even a notion of disorders of consciousness (coma). Diagnosis is usually made by detecting traces of protein in the liquid flowing into the nasal nostril. Radiological assessment is made, CT fine bone cut with a 3D reconstruction and brain MRI in high resolution multiplanar cuts especially in coronal section. Isotopic transit is done to confirm the leak of CSF. Once the diagnosis is made, the radiological assessment will give the exact location of the gap that will be subsequently operated by an endoscopic endonasal approach following its situation.

**2-2-surgical procedure:** The endoscopic approach is different depending on the situation of the CSF fistula, for the location at the cribriform plate of the ethmoid bone a trans-endoscopic approach is performed, a transsphenoidal approach is used for the superior orbital location (posterior wall of sphenoid sinus).

The patient is in a supine position; the patient's head is elevated to improve venous return with a slight extension of the head to facilitate exposure of the anterior face of the anterior cranial fossa. The anterolateral thigh is prepared to harvest the fascia lata plasty as in case of necessity. The multilayer technique is a practice described by Kassem et al for the repair of CSF leakage and osteo-dural defects. The patient is operated under general anesthesia with controlled blood pressure (hypotension) during the whole procedure. The surgical procedure is as following: identification of the fistula site, preparation of the defect, closing. It is supine position, the child's head is elevated to improve venous return with a slight extension of the head to facilitate exposure of the anterior face of the anterior cranial fossa. The anterolateral thigh is prepared to withdraw the fascia lata plasty as in case of necessity. After disinfection and decongestion of the nasal cavities, we begin the procedure by resection of the ipsilateral middle turbinate and a wide ethmoidectomy, it depends on the location of the fistula and depending on the exposure. Fistula is observed anterior of the ethmoid plate riddled with meningoencephalocele that appears under endoscope as a white tissue that covers the inferior surface of the right frontal lobe which leaves a clear cerebro-spinal fluid flow with a large bone defect.

The mucosal resection provides excellent adhesion of the graft to the skull base and prevents the formation of a mucocele. In the presence of meningoencephalocele, resection of herniated material is performed before the duraplasty. The overlay technique is applied mainly to repair the defect at the cribriform plate of the ethmoid. Generally we start by establishing a graft of synthetic dura cut in pieces measured by the width of the defect and must surpass a few millimeters. The graft is fixed under the plate extra cranially, followed by the establishment of the mucosa taken from the middle turbinate and the bones of the latter.

It ends with the building of the barrier by the application of nasal septal flaps of Hadad detached from the right side. Fibrin sealant tissucol of Baxter is applied only outside the transplant tissues at the end of the barrier formation, and the whole barrier implant is held by a ball stent (the ball using a urinary catheter) which puts pressure against the barrier.

**2-3-the postoperative period and long term followup :** Postoperatively, all patients remain in hospital for 7 days on antibiotics. All precautions are taken before any intervention by explaining to parents of children that the child will breathe through one nostril for 05journs and must avoid:-activities increasing intracranial pressure (tension, bending down position, work to lift a weight of 10 kg or more).-avoid sneezing open mouth, avoid blowing the nose, no lift.-The patient's head should be on a raised bed at 30 °.Endoscopic evaluation one month after the intervention is required. A radiological assessment is done routinely in all children after three months, and one year 06 months by doing a CT scan or MRI

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### **III. Results**

Our series includes 35 children with post-traumatic rhinorrhea associated with osteo-dural defect at the base of the skull. The study included 13 girls / 22 boys, mean age 8 years (range from 02-15years). The major symptom was unilateral rhinorrhea in all patients (100%), right in 25 patients (71.5%) and left at 10 children (28, 5%) lasting for a period ranging from 06months -24months. Recurrent meningitis was observed in 15 children (42.8%), disorders of consciousness in 05children (14, 2%). Isolated headache in 10 children (28.5%). All osteo-dural defects were identified preoperatively using a radiological protocol especially the brain scan in thin sections, in multiplanar bone window cuts (sagittal, coronal and frontal) showing the location and the width of osteo-dural defect at the skull base. The isotopic transit that affirms the existence of a CSF leak was performed in all children in pre- and postoperatively.

In 04 children (11, 4%), we found that the defect is associated with small meningoceles without cerebral hernia while in 8 patients (22, 8%) there was a meningo-encephalocele associated with osteo-dural defect more or less wide. The intraoperative endoscopic view confirmed the existence of a gap at the anterior floor of the skull base in all children, the cribriform plate of the ethmoid and the roof of the anterior and posterior ethmoid is the predilection in all patients (100%). The width of the defect varies from one child to another from 4mm- 10mm. We found that the defect is more common on the right than on the left (25 right against 10 left). The hospital stay varies between 7-10 jours, after removal of the ball on the fifth day the child will remain for monitoring for two to 04 days. We declare the absence of complications in intra or postoperatively after a long follow-up of 12-60 months, we have reoperated three cases of defects, the results is 100% successful.

### **III. Discussion**

The management of post-traumatic cerebrospinal rhinorrhea in children is a challenge for the neurosurgeon.

The neurosurgeon must clearly know this because he is the first to be able to track a cerebrospinal rhinorrhea and undertake an assessment leading to diagnosis. Its diagnosis is clinical (intermittent rhinorrhea and recurrent meningitis), biological and radiologic. The place of transferrin B2 and B-trace is essential to identify cerebrospinal fluid. The goal of radiology is to confirm the existence of CSF leakage, accurately indicate its location and if possible the cause, the least invasive way possible (3-4). Currently, the CT and MRI are the most suitable techniques to these requirements (3-4-12). They also help to perform a preoperative evaluation which will be mention all anatomical variants allowing the surgeon to choose the best surgical technique to obliterate the defect. T2 high resolution MRI shows the continuity between the cranial cavity and the nasal cavity in the presence of a meningoencephalocele, it differentiates between the nasal mass of inflammatory origin, or cystic tumor of meningoencephalocele (13).

The meningocele is typically hyperintense in T2 like CSF (13). Fluorescein is a green fluorescing visible under a white or blue fluorescing light. It helps to identify the CSF fistula and therefore the gap or opening in the dura, determine its importance during surgery and determine the appropriate level of reconstruction for each patient (1-6-7-8-15-18-19-20-28). The identification of fluorescein fistula intraoperatively or after closure means the need of revision of the closure or the use of a lumbar drainage postoperatively (16).

In our series, all patients were operated without the use of fluorescein. Several trans-cranial procedures have been proposed to repair the defects of the anterior skull base, always this approach can potentially affect the growth points of the cranial-facial skeleton, resulting in facial asymmetry, more mobilization one or both frontal lobes and damage of the olfactory fibers through the cribriform plate (13-21).

The endoscopic procedure is difficult in children because of the narrowness of the basal fossa and requires great surgical experience, we use specific micro-instruments dedicated to this surgery as a rigid endoscope 4 mm or 2.7 mm depending on the size of the nasal cavity. This endoscopic technique allows the repair of dural defects with minimal morbidity and preservation of smell.

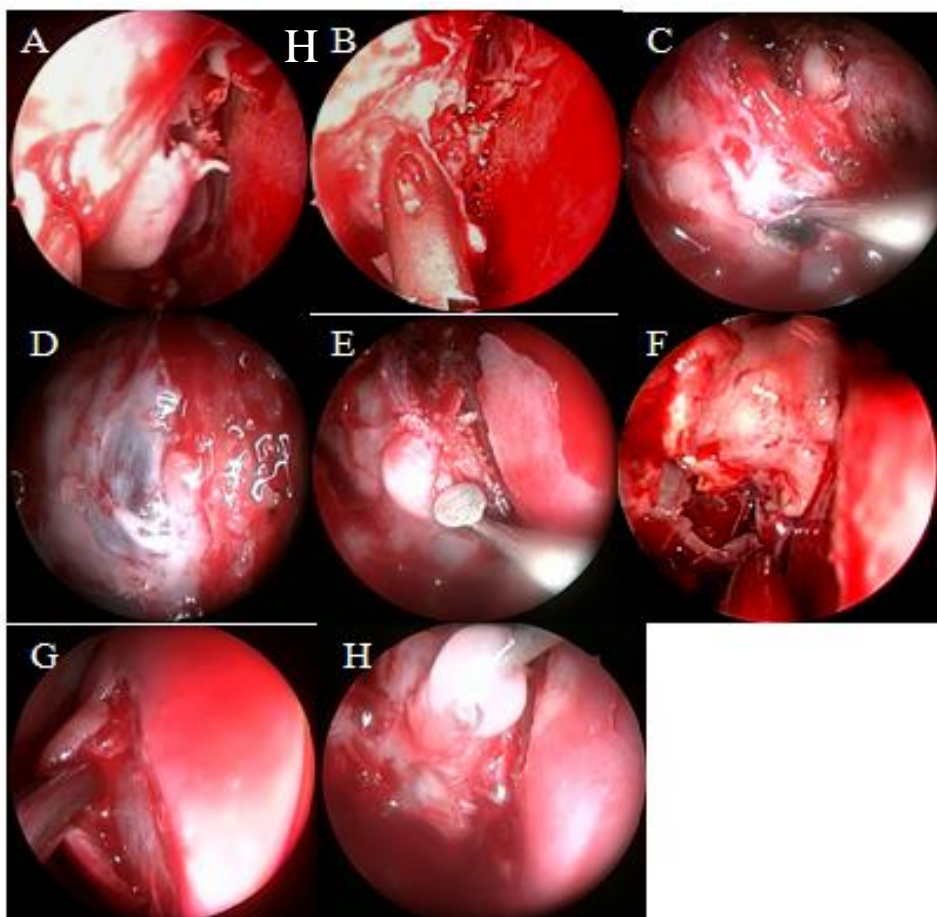
In the literature, several techniques and materials are described in the repair of CSF fistula including autologous materials such as abdominal fat, the lining of the nasal septum, bone, fascia lata and muscle grafts (1-2-6-21-22-24-25-26). In our series, we used the multilayer technique to repair all defects whatever the width and site. This technique has already demonstrated its effectiveness in adults in the literature and was used in 35 patients with a success which approaches (91, 4%) which allows to consider it as a gold standard in the treatment of post-traumatic cerebrospinal rhinorrhea in children.

Several synthetic materials were used in the repair of skull base after an expanded endoscopic plus free plasty technique, but these techniques are associated with a high incidence of CSF fistula (1-6-8-9-14-15-27). The use of vascularized tissues for repair provides fast and complete cure, for this reason the pedicle flaps as the temporoparietal fascia, skull peri-, and galeo-pericranial flaps were frequently used for reconstruction base skull after craniofacial surgery (2-23-24-25-26). These flaps require a large external incision, contrary to extended endoscopic approaches requiring the use of a vascularized pedicle from nasal septum muco-periosteum and muco-perichondrium vascularized by the nasal septal artery (7-13).

In 2005, HADAD BASSAGASTEGUY et al introduced the use of a nasal septal pedicle flap (flaps), it has a pedicle based at the posterior nasal septal artery that is a branch of the posterior nasal artery; these arteries provide an additional rich vasculature, this makes the flap foldable, their arc of rotation and coverage potential in the region (vascular tissue) are higher compared to the septal flap (24). In our series, we used the nasal septal flap of Hadad in all children. A study by Zweig et al showed that the type of graft placed in position over or underlay and use of fibrin glue or Surgicel does not influence the postoperative status, but anyhow we believe it is prudent using them (11).

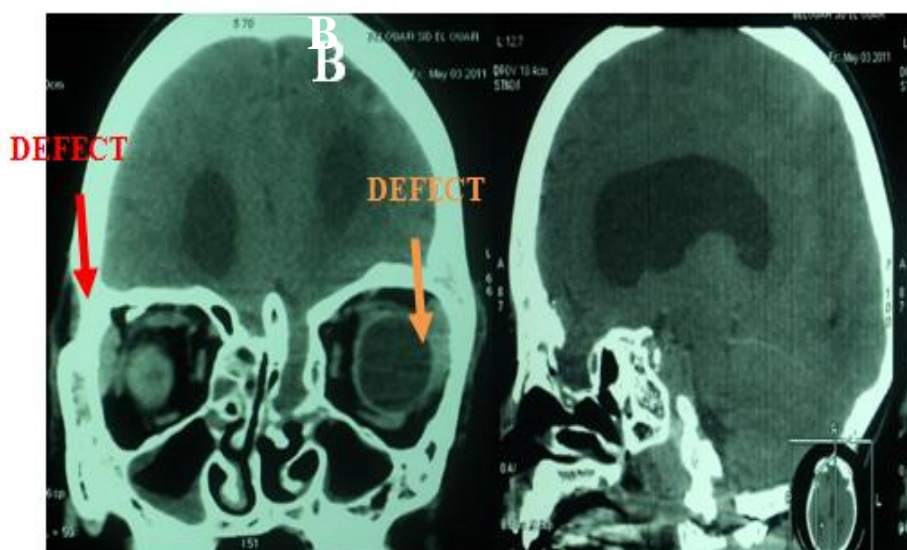
We did not use the lumbar drainage postoperatively because we believe that the post-traumatic fistulas are not associated with increased intracranial pressure. All authors agree with (1-6-8-10-14-19-22-30) the endonasal endoscopic approach that it is a minimally invasive way, safe and effective in children with less morbidity and without complications. These data are in concordance with our results, the success rate is around 91.4% and it is 100% in the case of reoperation.

### **Figures And Tables**

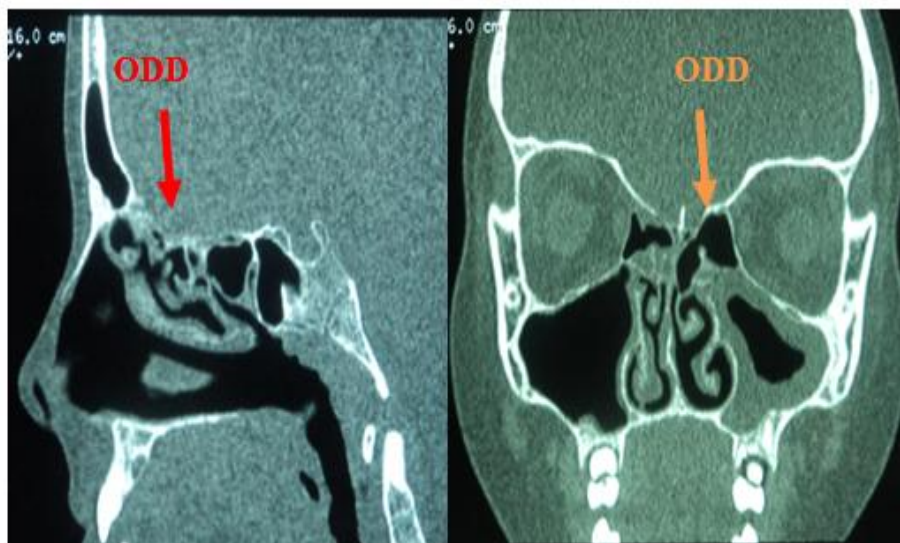


**Fig 1 :** intra operative endoscopicview showing different steps of the surgicalprocedurewith the multilayerstechnic.

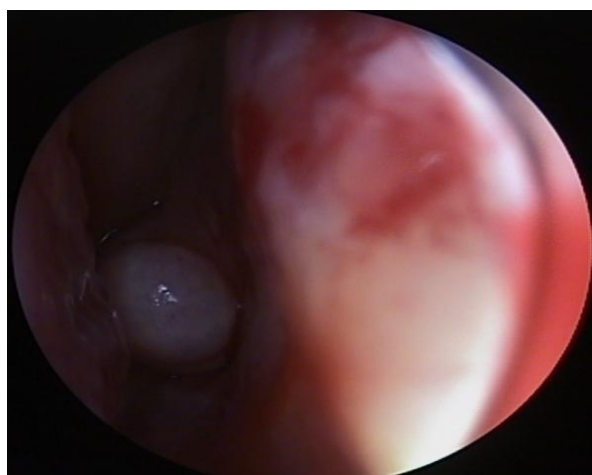
**A-**incision of unciform process after middle turbinet resection. **B-**ethmoidectomy.**C-**detachment of dura from the edges of the bone defect. **D-** preparation of bone defect for repair. **E-** placing the first layer of fascia lata.**F-** placing the la mucus membrane of the middle turbinet. **G-** incision of the mucus septum **H-** placing of the fibrin glue.



**Fig2 :** Preoperative Images Of Ct Scan In Coronal And Sagittal Cuts Showing An Osteo-Dural Defect At Theleft Cribriformplateof Etmoid.



**Fig3 :**Preoperative Images Of Ct Scan In Coronal And Sagittal Cuts Showing An Osteo-Dural Defect At The Right Cribriformplateof Ethmoid.



**Fig4 :** Intra Operative Endoscopic View Of A Small Right Meningocele.

#### IV. Conclusion

Post-traumatic cerebrospinal rhinorrhea in the child situated at the cribriform plate and the roof of the ethmoid are treated by endoscopic endonasal approach and closing is done by the multilayers technique with a nasal septal pedicle flap. This minimally invasive approach avoids all the complications of transcranial approach. Minimally invasive techniques continue to evolve with low morbidity and a success rate close to 90%. The endonasal endoscopic approach has become the gold standard for treating CSF leakage in the anterior floor of the skull base.

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