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# **Pediatric endonasal dacryocystorhinostomy and operative standardization<sup>1</sup>.**

La dacryocystorhinostomie par voie endonasale chez l'enfant et sa  
standardisation opératoire

NGUYEN Diem-Trang<sup>1,2\*</sup> MD, FAYET Bruno<sup>1,2</sup> MD RACY Emmanuel<sup>3</sup> MD, SUSTRONCK  
Pierre<sup>4</sup> MD, BREMOND GIGNAC Dominique<sup>1,2</sup> MD-PHD

1. Service d'Ophtalmologie Hôpital universitaire, Necker enfants malades, APHP, 149 rue  
de Sèvres, Paris

2. Université Paris V René Descartes

3. Fondation Saint Jean de Dieu, 19 rue Oudinot, Paris

4. Service d'Ophtalmologie du Centre Hospitalier Intercommunal de Créteil CHIC, 40  
avenue de Verdun, Créteil

\*auteur correspondant : NGUYEN Diem-Trang

[diemtrang.nguyen@gmail.com](mailto:diemtrang.nguyen@gmail.com)

+33631255795

1 bis av de gravelle, 94 220 Charenton le Pont, FRANCE

Titre court : Pediatric endoscopic dacryocystorhinostomy

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## **ABSTRACT**

**Objective:** The objective of this study was to confirm that the standardized endonasal dacryocystorhinostomy (DCR) technique routinely performed in adults can be used in children.

**Materials and methods:** A consecutive series of children undergoing endonasal DCR between 2003 and 2017 was analysed. The surgical procedure consisted of: preoperative CT scan, anatomical localization of the ideal surgical zone, access to the nasal cavity via an optional planned enlargement, creation of a mucoperiosteal flap, osteotomy with rongeurs and equatorial resection of the medial wall of the lacrimal sac. This pediatric series was compared to a series of adult patients operated according to the same standardized technique.

**Results:** A total of 20 DCRs (17 patients, with a mean age of 8 years (range: 4-16)) were included. Anatomical localization was effective in 100% of cases without the need for transillumination. With a mean follow-up of 4 years, the success rate was 95%, and no major complications were observed. Comparison with the same surgical technique in adults revealed similar results.

**Discussion:** Our experience suggests that standardized endonasal DCR can be adapted to the nasal cavities of children. Anatomical localization is effective. The physiologically narrow nasal cavity does not constitute a major obstacle with the use of slightly smaller instruments. The results and complications are similar to those observed in adults.

**Conclusion:** The same standardized endoscopic endonasal DCR surgical technique can be used in adults and children with a similar good success rate.

**Key-Words:** dacryocystorhinostomy; unciformectomy; uncinectomy; lacrimal duct obstruction; nasolacrimal duct obstruction; pediatrics.

## **RESUME**

**Objectif:** Confirmer que la technique standardisée de dacryocystorhinostomie (DCR) endonasale par endoscopie utilisée en routine chez l'adulte est applicable chez l'enfant.

**Matériel et méthodes:** Une série de cas consécutifs de chirurgie de DCR par voie endonasale chez l'enfant entre 2003 et 2017 a été analysée. La procédure consistait en : un TDM pré opératoire, une localisation anatomique de la zone chirurgicale, l'accès à la cavité nasale par un élargissement programmé optionnel, la création d'un lambeau mucopériosté, une ostéotomie à l'aide de rongeurs, et la résection du mur médial de la muqueuse du sac lacrymal. Cette série pédiatrique était comparée à une série adulte opérés selon la même technique standardisée.

**Résultats:** 20 cas (17 patients) ont été inclus, avec une moyenne d'âge de 8 ans (4-16). La localisation anatomique était efficace à 100% sans l'aide de transillumination. Après un suivi moyen de 4 ans, le taux de succès était de 95% et aucune complication majeure n'a été observée. La comparaison avec la même technique chirurgicale chez l'adulte a retrouvé des résultats similaires.

**Discussion:** Notre expérience suggère que la technique standardisée de DCR endonasale par endoscopie peut être transposée aux cavités nasales de l'enfant. La localisation anatomique était efficace. L'étroitesse physiologique de la cavité nasale ne constitue pas un obstacle majeur avec l'utilisation d'instruments légèrement plus petits. Les résultats et les complications sont similaires à ceux des adultes.

**Conclusion:** La même technique chirurgicale standardisée de DCR endonasale par endoscopie peut être utilisée chez l'adulte et l'enfant avec un bon taux de succès.

Mots clés : dacryocystorhinostomie ; unciformectomie ; obstruction des voies lacrymales ; imperforation lacrymo-nasale ; pédiatrie

## INTRODUCTION

Dacryocystorhinostomy (DCR) is performed to treat nasolacrimal duct obstruction refractory to probing and/or intubation. Due to its simplicity and reproducibility, external DCR is still the reference technique in both adults and children. However, endonasal DCR has been increasingly used over recent years [1, 2]. The surgical technique in adults has been progressively standardized according to mirror transposition of the technique described by Blaylock et al., based on cleavage of the maxillo-lacrimal suture [3] and with the creation of a circular zone of clearance around the common canaliculus, as recommended by Whelham [4]. According to the standardized technique, the osteotomy must be situated in the superior part of the lacrimal fossa, corresponding to the site of the vertical part of the uncinat process in 90% of cases [5,6], which constitutes the wall of the first ethmoidal air cell. This standardization process also comprised planned enlargement of the nasal cavity whenever necessary, anatomical landmarking of the lacrimal fossa, osteotomy with rongeurs and equatorial resection of the medial wall of the lacrimal sac. The success rate in adults, without transillumination and without Killian-type speculum, was 94% [7].

External DCR has remained the reference technique in children for many years due to the narrow nasal cavity. However, the endonasal approach has been reported in the literature over recent years, although no consensus has been reached concerning the optimal technique and instrumentation.

We report the results of this standardized endonasal DCR in children.

## MATERIALS and METHODS

This retrospective study was based on a series of 20 consecutive cases (17 children) of endoscopic endonasal DCR performed between 2003 and 2017. DCR was indicated for nasolacrimal duct obstruction refractory to classical first-line treatments, probing and/or intubation. The two authors, B.F. and E.R., performed all of these consecutive surgical procedures.

All patients underwent a complete preoperative clinical examination, including examination of the eyelids and lacrimal meati. The parents were provided with oral and written information about the advantages and disadvantages of external and endoscopic DCR. This written information was established by French academic societies (SFO and SNOF) and was available from their websites.

Preoperative lacrimal duct CT scan was performed to exclude any contraindications to endonasal surgery.

Exclusion criteria were canalicular stenosis, lacrimal sac diverticulum, acute lacrimal sac abscess, facial cleft, Down syndrome, history of facial trauma.

### **Surgical technique**

The standardized technique has been described in detail before [7,8]. All procedures were performed under general anaesthesia. The operative site was visualized with a rigid 4 mm endoscope connected to a video camera system.

Planned enlargement of the middle nasal meatus was performed, whenever necessary, based on assessment after mucosal vasoconstriction by a nasal vasoconstrictor pack for 5 minutes with 5% Xylocaine and naphazoline (lidocaïne HCl, Naphazoline nitrate, Astra Zeneca, Rueil Malmaison, France). The middle meatus was enlarged in order to provide access to the ideal surgical zone, without inducing mucosal injury (responsible for bleeding

followed by synechia). Anterior middle turbinectomy was performed with curved scissors. Hemostasis was realized as the surgery progressed with bipolar cautery.

To create the mucoperiosteal flap, the nasal mucosa incision was initiated immediately adjacent to the operculum of the middle turbinate and was then extended to the inferior turbinate. The flap was then medialized. The vertical part of the uncinat process (UP) was detached whenever it was interposed in the way. *En bloc* unciformectomy provided access to the maxillolacrimal suture (MLS), situated 1 to 2 mm posteriorly to the operculum of the middle turbinate. [5,6,9].

The osteotomy was performed using 2 mm diameter rongeurs with the jaws opened to 90°. In the first six cases, complementary protected drilling with 2 mm drills was performed to enlarge the osteotomy in the zone of the operculum. In the last 14 cases, this enlargement was performed using 2 mm diameter rongeurs with the jaws opened to 45°. All of the medial wall of the lacrimal sac was incised at the equator, and then removed, leaving a circular zone of osteomucosal clearance around the common canaliculus.

Nasal packing was realized after surgery with a resorbable haemostatic compress. Patients remained in hospital overnight after surgery. Postoperative treatment consisted of a combination of antibiotic and corticosteroid eye drops for one week, four times a day.

The surgical success of endonasal DCR was assessed by the resolution of all clinical symptoms and absence of mucocele (Figure 1).

## RESULTS

Twenty cases of DCR performed in 17 patients (13 boys (76%) and 4 girls (26%) with 3 bilateral procedures and 14 unilateral procedures) satisfied the inclusion and exclusion criteria. The patients' clinical characteristics are summarized in Table I. The mean age of

the patients was 8 years (range: 4-16 years) and the mean follow-up was 4 years (range: 1-13 years).

The overall success rate was 95%. No external transformation of the procedure was required. Transillumination, Killian-type speculum, intubation probe, or turbinate splint were not used in any of these cases. No major operative or postoperative complication was observed (Table 2).

The nasal cavity of 10 children was reviewed endoscopically with a mean follow-up of 28 months. In these 10 cases, the marsupialized lacrimal sac in the lateral wall of the middle meatus had a recess-like appearance. The clearly visible common canaliculus opened freely onto the superolateral part of the lacrimal sac. No interparietal synechiae were observed (Figure 2).

One case (5%) of persistent lacrimation was observed in a patient who had previously undergone external DCR. Repeat endoscopic endonasal DCR was performed and partially resolved this sump syndrome (with a follow-up of 2 years).

## DISCUSSION

There are now many publications in the literature concerning endonasal DCR in either adults or children [1, 2, 9-14]. However, no consensus has yet been reached concerning the optimal technique. Only rare studies have used the same technique in adults and in children. Standardization of endonasal DCR based on mirror transposition of standardized external DCR [3,4] has been validated in adults. Operative standardization in adults comprises: exclusively anatomical landmarking based on the operculum of the middle turbinate, optional planned enlargement, osteotomy with rongeurs [7,8] and equatorial resection of the medial wall of the lacrimal sac. This operative standardization ensures reproducible results in adults. The advantage of operative standardization is to allow all

nasal cavities to be operated despite anatomical variants. Paediatric endoscopic endonasal DCR does not appear to be technically very different from adult endoscopic endonasal DCR, apart from the small dimensions of the nasal cavity. Table 2 compares the present paediatric series with a series of 300 adult cases performed by the same surgeons according to the same technique [7].

Planned enlargement was almost easier to perform than in adults. In adults, septoplasty was required in 27% of cases and resection of the middle turbinate was required in 75% of cases. In children, despite the narrow nasal cavity, septoplasty was never required due to the absence of deviated nasal septum. It should be stressed that septoplasty is not recommended in children to avoid interfering with nasal growth and the aesthetic appearance. The anterior middle turbinectomy rate in children was 35%, much lower than that observed in adults. Sufficient space was obtained in every case, allowing instruments to be advanced to the middle nasal meatus without damaging the adjacent mucosa. The initial dimensions of the nasal cavity therefore did not appear to be an obstacle to endonasal surgery. No reference to the lower age limit for endonasal surgery was found in the literature, but we currently adopt an arbitrary age limit of 4 to 5 years, giving anatomic conditions compatible with the use of a rigid 4 mm endoscope without trauma and allowing a reasoned post operative management.

Creation of the mucoperiosteal flap was performed in exactly the same way as in adults.

No consensus has been reached concerning the optimal site of initiation of the osteotomy. In classical endonasal DCR, the osteotomy is initiated in the maxilla, over the lacrimal ridge [15-18] and is then progressively extended posteriorly to expose the lacrimal sac. This

approach is simple but is not based on any reliable landmark. McDonogh and Meiring showed that unciformectomy provided access to the maxillofacial suture [9], opening the way to mirror transposition of standardized external DCR.

Clinicoradiological correlations in adults show that the maxillofacial suture is situated immediately posteriorly to the operculum of the middle turbinate [7, 19-21], which was confirmed in all children of the present series. The operculum of the middle turbinate is the fundamental, reliable anatomical landmark to localize the maxillofacial suture, independently of anatomical variants of the nasal cavity and the patient's age [5].

Transillumination has consequently become unnecessary, except in particular cases.

The value of this anatomical landmark is confirmed during osteotomy. Identification of the maxillofacial suture indicates a reliable and reproducible starting point for the osteotomy. As in adults, 90° bone rongeurs were used. Only the diameter of the rongeurs differed: 2 mm in children and 3 mm in adults. As in adults, the 45° rongeur has replaced drilling of the opercular zone (the most anterior insertion of the middle turbinate on the lateral wall of the nasal cavity). Following cleavage of the maxillofacial suture, the osteotomy was performed in retrograde fashion. The osteotomy was considered to be sufficient when the medial wall of the lacrimal sac was free of any interposed bone. Compared to bone drilling, even protected drilling, the use of rongeurs eliminates the risk of burns and inflammation. No cases of postoperative cacosmia or osteomyelitis were observed. However, rongeurs alone were not used for all the cases (first 6 cases with complementary protected drilling). Osteotomy with rongeurs is easier to control. No oculomotor muscle injury or perforation of the midcanthal region or medial wall of the orbit was observed in this series.

No consensus has been reached concerning restoration of continuity between the lacrimal mucosa and the nasal mucosa. Even the definition of these mucosal flaps is variable in terms of their nature, dimensions, shape, base and whether or not they are sutured [22]. Possible retraction, dislocation or even necrosis of these flaps cannot be formally excluded. Endoscopic examinations cannot be easily performed in children, especially during the immediate postoperative period. It is difficult to know what really happens during the first month of healing and identify which aspects are truly contributive. We have tested all of these hypotheses in adults without observing any difference compared to simple equatorial resection of the medial wall of the lacrimal sac.

We believe that creation of a mucosal flap is a minor point, as the essential element is to ensure that the osteotomy creates the best conditions to create a circular zone of clearance around the common canaliculus. The posterior part of the lacrimal sac must be free of any fragments of lacrimal bone or uncinata process adherent to the sac in order to allow creation of a lacrimal recess, the base of which corresponds to the orifice of the common canaliculus. The medial wall of the lacrimal sac must be entirely resected, but the lateral wall must be left intact.

Our success rate with this technique was 95%, similar to the success rates reported in the literature [15, 23, 24], and comparable to our results in adults [7]. In this 20 cases series, patients with medical past history of chronic dacryocystitis had similar results. The success rate of the largest paediatric series of endoscopic endonasal DCR (83 cases) was 92.7% [10].

Postoperative follow-up was available for only 10 nasal cavities due to lack of cooperation. Endoscopic examination did not reveal any synechiae. Although initially more complicated, the postoperative course after planned enlargement is simpler than that observed after iatrogenic mucosal injury.

The main difficulty of endoscopic endonasal DCR concerns the learning curve, which is simplified as a result of this standardization. Complications can occur after endonasal DCR, both in adults and in children, but with different complication rates. Potential complications include bleeding, infection, cacostmia, orbital or intracranial trauma, lacrimal sac fibrosis [19]. None of these complications was observed in the present series. The only case of failure was observed in a context of reoperation after external DCR with sump syndrome.

## CONCLUSION

Our results favour the use of standardized endonasal DCR in children. It appears to be effective and safe, providing good clinical and functional results. Thus, operative standardization of endonasal DCR can be performed in adults as well as in children.

## DISCLOSURE OF INTEREST

The authors declare no conflicts of interest related to this article.

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## LEGENDS

**Figure 1.** Operative aspect of endonasal DCR in a child of 6 years old, right nasal fossa. A. General view: nasal septum does not block out the progression of instruments; B. Cleavage of the mucoperiosteal flap; C. End of the osteotomy, lacrimal bone needs to be peeled and resected; D. Medial wall of the sac is free, with a lacrimal probe inserted for tension; E. Opening of the lacrimal sac; E. Operative aspect after marsupialization eliminating the medial wall. LB : lacrimal bone ; LS : lacrimal sac ; MB : maxillary bone ; MT : middle turbinate ; NS : nasal septum.

**Figure 2.** Post operative aspect in a child of 6 years old, left nasal fossa, with 24 months follow up. A. General view of the surgical field (lacrimal sac: dotted circle); B. Junction between lacrimal cavity and nasal mucosa; C. A lacrimal probe is guided toward the sac; D. Common canaliculus opens in the lateral wall of the sac, at the top of the lacrimal sac opening. MT : middle turbinate ; MB : maxillary bone ; NS : nasal septum; Arrows draw the limits of the lacrimal apse.

Characteristics of the patients	All procedures (n= 20), all patients (n=17)
Mean age (years)	8 years (4-16)
No. of female patients	4 (24%)
No. of bilateral procedures	3 (15%)
Mean follow-up period (years)	4 years (1-13)
No. of revisions	1
Success rate	95 %

Table 1. Clinical characteristics of the patients

	Number of cases	Period	Age	Surgical technique		Results			Postoperative complications	
				Septoplasty	Anterior turbinectomy	Residual epiphora	Sump syndrom	Mucocele recurrence	Cicatrization of the ostium	Bleeding controlled by packing >24h
Series previously published in adults [7]	300 (271 patients)	2007-2011	66 (24-94)	82 (27%)	225 (75%)	18 (6%)	1 (0,3%)	2 (0,6%)	15/300 (5%)	2 (0,6%)
This pediatric series	20 (17 patients)	2003-2017	8 (4-16)	0	7 (35%)	1 (5%)	1 (5%)	0	0/10	0

Table 2. Comparison of surgical outcomes in a previously reported series of 300 adults cases of endoscopic endonasal DCR with the current pediatric series performed by the same surgeons B.F. and E.R.s [7]



