

# Dacryocystorhinostomy: Evolution of endoscopic techniques after 498 cases

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## Abstract

**Introduction:** Endoscopic dacryocystorhinostomy is a well-known surgical practice used to treat nasolacrimal duct obstruction and widely considered as a valid alternative to external approaches.

**Purpose:** We present a retrospective case series of 498 endoscopic dacryocystorhinostomies on 401 patients, from July 2004 to May 2018, at the Department of Otolaryngology, San Raffaele Hospital, Milan, Italy.

**Methods:** Of the 498 procedures, 426 were unilateral and 72 were bilateral dacryocystorhinostomy. All patients underwent routine preoperative workup including fluorescein test (Jones test 1–2), probing and irrigation of the lacrimal way, nasal endoscopy, and maxilla-facial computed tomography scan. Surgical technique was based on nasal endoscopic dacryocystorhinostomy followed by positioning of a Catalano's silicone stent, which was left in place for about 3 months. Anatomical success was defined as a patent ostium on irrigation, whereas functional success was defined as free lacrimal flow on functional test and resolution of epiphora.

**Results:** Anatomic success was achieved in 91.54% cases in primary dacryocystorhinostomy and in 89.36% after revision, whereas functional success was obtained in 90.4% in primary and 85.1% in secondary dacryocystorhinostomies. After a second revision of endoscopic dacryocystorhinostomy, anatomical success was achieved in 90.1% and functional success in 88.7% of procedures.

**Conclusion:** Our results confirm that endoscopic dacryocystorhinostomy can be considered as a valid surgical approach to primary nasolacrimal duct obstruction and revision cases. The key aspects in achieving functional and anatomical results are meticulous surgical procedure and precise follow-up.

## Keywords

DCR, nasolacrimal duct obstruction, endoscopic dacryocystorhinostomy

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## Introduction

Nasolacrimal duct obstruction (NLDO) is a common pathology that prevents natural eye to nose tears, leading to the common symptom of epiphora; however, the intensity of symptomatology and objective findings are not always strongly correlated.

The causes of obstruction in NLDO may range from congenital to acquired: primary acquired nasolacrimal duct obstruction (PANDO) is commonly caused by unknown fibrosis or inflammation and is more common in adult women, whereas secondary acquired NLDO can occur, for example, because of trauma, surgery, or neoplasms.<sup>1</sup>

With the introduction of advanced fiberoptic endoscopes, nasal endoscopic dacryocystorhinostomy (END-DCR) has become a well-tolerated and successful procedure

for NLDO.<sup>2</sup> With this surgical approach, a permanent connection between the lacrimal sac and the nose is made without cutaneous incision or disruption of the lacrimal pump.<sup>3</sup> Additional advantages of END-DCR are reduced operative time, post-surgical morbidity, and early recovery.<sup>4</sup>

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The standard surgical endonasal approach consists of the creation of the largest possible osteotomy and sac marsupialization, which is associated with high short-term success rates. Nevertheless, long-term success rates may range between 81% and 96%,<sup>3,5-8</sup> which is comparable to that of a traditional, external approach.<sup>3,9,10</sup>

The aim of this study is to report our clinical and surgical experience on 498 consecutive cases of END-DCR, discussing clinical and surgical outcomes and follow-up.

## Materials and methods

In this retrospective study, we included all patients who underwent END-DCR for NLDO between July 2004 and May 2018 at the Department of Otolaryngology, San Raffaele Hospital, Milan, Italy.

Informed consent was obtained from each patient for treatment and use of de-identified clinical data for study purposes. We obtained approval from the institutional review board (IRB) of San Raffaele Hospital for this clinical review study, which was conducted according to the ethical standards established in the 1964 Declaration of Helsinki, as revised in 2000.

All patients had a clear diagnosis of NLDO made by multidisciplinary agreement between an otolaryngologist and ophthalmologist with unanimous agreement on the site of obstruction. Multidisciplinary diagnostic workup was performed according to the preoperative analyses proposed by Trimarchi et al.<sup>1</sup> In particular, it is based on functional fluorescein test (Jones test 1 and 2), lacrimal probing, and irrigation; as part of the workup, after clinical evaluation, nasal endoscopy and maxilla-facial computed tomography (CT) scan were carried out to assess nasal anatomy. Patients with immunologic deficiency, congenital pathology, canalicular abnormalities, and nasal dysmorphisms were excluded from the study. All patients underwent END-DCR by the same otolaryngologist and ophthalmologist.

### Surgical technique

The surgical aim was to create a patent communication between the lacrimal sac and nasal cavity. Under general anesthesia, using a 30° endoscope, the maxillary line was identified and a mucosal flap was raised posteriorly to expose the lacrimal bone. The incision started at the middle turbinate axilla, continuing 5 mm anteriorly, then a cranio-caudally direction, parallel to the maxillary line, was taken until insertion of the inferior turbinate; finally, the incision continued 8 mm posteriorly. The lacrimal bone was then palpated to detect the junction with the frontal process of the hard palate. Using a powered instrument, the lacrimal bone and the lower part of the frontal process were removed. While the medial wall of the lacrimal sac was exposed, a Bowman's probe was used by an

ophthalmologist to tent the medial sac wall passing through the inferior punctum. The tip of this instrument was used as a guide to make a vertical incision of the lacrimal sac, and an anterior and posterior releasing incisions were then made, creating an "H" shape. The horizontal cuts allowed for creation of an "open book" flap that was rolled out on the lateral wall of the nose. The ophthalmologist then dilated the upper and lower puncta using a Catalano stent that was retrieved endonasally, and looped.

Finally, the initial nasal flap was reflected back and cut to create an "L"-shaped flap, covering the posterior and inferior part of the new rhinostomy. We did not routinely use nasal packing after DCR surgery, except in two cases of intense post-operative bleeding. In these cases, packings were removed on the first post-operative day.

All patients received post-operative oral antibiotics (amoxicillin + clavulanate) and were instructed to perform nasal saline douching, use emollient local ointment, and apply antibiotic-steroid eye drops for a 7-day period. Local nasal therapy was continued until the rhinostomy was entirely healed.

Follow-up visits were performed on days 1 and 4, once a week for the first month, once a month for 3 months, every 6 months for 1 year and then once a year. Post-operative follow-up ranged from 4 to 168 months (mean=38.07). All clinical evaluations consisted in lacrimal pathway irrigation and nasal endoscopy to evaluate patency of the rhinostomy.

The silicone Catalano's tube remained in place from 3 to 4 months. Anatomical success was described when a patent ostium on irrigation was achieved, whereas functional success was defined as free lacrimal flow on functional test and resolution of epiphora.

## Results

The study group included 502 procedures using endoscopic endonasal powered DCR on 401 Caucasian patients (110 males and 291 females), aged 5–84 years (average age=58 years), with a diagnosis of NLDO. In our case series, we collected both primary and secondary NLDO: secondary causes included those due to facial trauma (n=5), radioiodine therapy (n=3), radiotherapy (n=3), Wegener granulomatosis (n=5), and chemotherapy (n=1).

The male to female ratio was 1:2.6 (110:291); 92 of the 502 surgical procedures were presented in a previous publication.<sup>1</sup> During our study, four subjects were excluded because of diagnosis of malignancy (two melanomas, one squamous cell carcinoma, and one inverted papilloma). Of the 498 procedures, 426 were unilateral and 72 were bilateral DCRs.

Considering all END-DCRs, 80.7% were primary (402/498) and 19.3% (96/498) were secondary (Table 1). When primary END-DCR was not efficient in treatment of epiphora, we usually performed a second endoscopic procedure.

**Table 1.** Results of primary and secondary dacryocystorhinostomy.

	Primary DCRs	Secondary DCRs	Primary + secondary DCRs
Number of procedures	402	96	498
Anatomical success	91.5% (368)	89.4% (84)	90.1% (449)
Functional success	90.4% (362)	85.1% (80)	88.7% (442)

DCR: dacryocystorhinostomy.

Among revision cases, external DCR was previously performed in 43.75% (42/96) patients, an endoscopic approach in 37.5% (36/96), and transcanalicular surgery in 18.75% (18/96).

Only two patients who had received two END-DCRs from our institution underwent a third endoscopic procedure, with a success rate of 50%. In all patients with non-successful surgical therapy after two DCRs and in one patient who received three END-DCRs at San Raffaele Hospital, a Jones tube was placed.

When END-DCR was performed, a Catalano's stent was placed for 3–4 months: in particular, only five patients kept the stent in place for 4 months due to personal issues. The mean operative time for primary DCR was 25 min (range=15–35), while it was 22 min (range=10–40) for secondary DCR.

All patients examined presented significant preoperative epiphora that was associated with purulent discharge (n=58), acute dacryocystitis (16 in primary DCRs, 8 in secondary DCRs), dacryocystocele (n=6),<sup>11</sup> and presence of lacrimal calculi (n=2).

During END-DCR, 85 patients (21.2%) required the following as an additional procedure: 10.5% (42/401) endoscopic septoplasty,<sup>12</sup> 5.7% adjunctive sinonasal surgery, 2.7% middle turbinate plasty, 2% synechia lysis, 0.3% (n=1) dental implantation treatment,<sup>13</sup> and 0.3% (n=1) punctumplasty.

Observed complications included epistaxis (n=4), edema of the eyelid (n=25), turbino-septal synechia (n=8), laceration of the lacrimal canaliculi (n=3), ostium granulomas (n=15; 6 treated with topical cortisone, 9 treated surgically),<sup>14</sup> and lacrimal stent dislocations (n=16) that were properly repositioned with a nasal endoscope.

At last follow-up, final anatomic success was achieved in 91.54% cases in primary DCR and in 89.36% in revisions, whereas a functional result was obtained in 90.4% in primary and 85.1% in secondary DCRs. Considering the initial endoscopic procedure (498), DCR surgery was anatomically successful in 90.1% and functionally successful in 88.7% of procedures.

Among treated cases, no factors showed a significant difference between successful and unsuccessful treatment, including sex (p=0.561) or age (p=0.240). Only a history of chemotherapy (p=0.001) and radiotherapy (p=0.04) had significant p values; however, in our case series, there

were few patients with such secondary NLDO causes (chemotherapy=1, radiotherapy=3), making the results of little statistical relevance.

No other causes of NLDO showed significant p values (p>0.05). Statistical analysis was not performed for timing of silicone stenting or race due to the homogeneity of cases.

## Discussion

NLDO is a common pathology that can be treated with various types of approaches, both surgical and nonsurgical. Nasal END-DCR is one of the most widely used techniques since it usually achieves high success rates with low morbidity and aesthetic problems.<sup>10</sup>

While the success rates of END-DCR in the literature range from 75% to 96%,<sup>3,9,15–18</sup> our retrospective case series documented an anatomic success rate of 91.54% in primary DCR and 89.36% in revisions, with a functional success of 90.4% in primary and 85.1% in secondary DCRs.

In only two patients were three END-DCRs needed, with a functional success rate of 50%. In particular, the patient who did not achieve a functional result had been previously treated for a thyroid cancer with I-131, which is known to alter the healing process in 2.2%–18% of patients.<sup>19</sup>

To establish the correct approach to NLDO, prior to surgery, accurate and specific diagnosis was made through multidisciplinary consultation between an ophthalmologist and an otorhinolaryngologist. All patients should follow a diagnostic workup that starts with the Jones test 1 and 2 (fluorescein test), usually performed by an ophthalmologist. These tests are considered non-invasive procedures that determine if lacrimal stenosis is functional or obstructive. Probing and irrigation of the lacrimal system is the second ophthalmologic step and is a safe, easy, and low cost way to establish correct diagnosis. These clinical evaluations can be used, in the majority of cases, to diagnose nasolacrimal obstruction.<sup>20</sup> Some authors routinely complete diagnostic workup with dacryocystography or dacryoscintigraphy, which may be useful in detecting nasolacrimal anatomy. The review proposed by Lefebvre and Freitag<sup>20</sup> suggests that these radiological tools are useful only when there is suspicion of complicated anatomy or a need for re-operation.

In order to evaluate nasal anatomy, we usually perform nasal endoscopy and maxilla-facial CT scan, which are helpful in detecting the exact position of the uncinata process and its relationship with the lacrimal system. In addition to this, radiological imaging can reveal potential sinus diseases and pneumatization of the agger nasi. However, especially in the pediatric population, CT radiation can be an issue, but, in agreement with the review of Lefebvre and Freitag,<sup>20</sup> the additional significant information that can be obtained from a CT scan (sinonasal malformations or pathologies such as concomitant sinusitis or concha bullosa of the middle turbinate) is useful to perform a correct END-DCR.

To prevent early obliteration of the new rhinostomy after END-DCR, we used a Catalano's stent that was kept in place for 3–4 months. This silicone device may lead to correct healing, but can cause formation of granulation tissue, infection, and ulceration of the lacrimal pathway. In addition to this, it can dislocate and cause patient discomfort, leading to mandatory stent re-positioning.<sup>1</sup>

In the literature, different approaches to NLDO have been used with a wide range of success rates.<sup>3,5,8,10,15–17,21–25</sup> In particular, NLDO can be treated with both surgical techniques, such as external dacryocystorhinostomy (EXT-DCR) and END-DCR, and nonsurgical procedures, such as radiological placement of nasolacrimal stents<sup>24–27</sup> and balloon dacryocystoplasty.<sup>22,23</sup> Radiological intervention has a significantly lower success rate, but can be used in specific types of patients who cannot be subjected to general anesthesia.<sup>28</sup> In recent years, many groups have compared EXT-DCR and END-DCR.<sup>10,15,21,29–31</sup> Huang et al.<sup>10</sup> carried out a meta-analysis and systematic review on surgical DCR approaches: comparable results were seen between EXT-DCR and mechanical END-DCR with reported revision surgeries similar in both approaches (risk ratio (RR)=1.02; confidence interval (CI)=0.98–1.06). Hartikainen et al.<sup>9</sup> compared endonasal laser-assisted DCR with external DCR and reported significantly better outcomes with EXT-DCR (63% vs 91%). However, END-DCR has some advantages over EXT-DCR such as limited invasiveness, shorter operative time, preservation of pump function, less bleeding, and absence of skin trauma that can lead to an external scar.<sup>1</sup> Recently, Ng et al.<sup>32</sup> described a new surgical EXT-DCR technique in which the external cutaneous scar can be avoided, thanks to a periciliary incision, making the procedure more aesthetically desirable, with a functional success rate of 83.3%. Similar aesthetic external surgical approaches have been proposed by other authors with variable results.<sup>33–37</sup>

Compared to our previous study,<sup>1</sup> anatomical and functional success rates seem to be lower. This is possibly due to the greater number of procedures performed, heterogeneity of patients, specific multidisciplinary selection of patients, and longer follow-up time.

When END-DCR is concluded, some authors complete the procedure with silicone intubation of the nasolacrimal

pathway.<sup>38</sup> Kim et al.<sup>39</sup> evaluated the effect of silicone stent intubation during END-DCRs by meta-analysis: it was reported that, even if there was no significant heterogeneity between the studies analyzed and the use of a silicone stent seems to increase the success rate compared to the control group (odds ratio (OR)=1.45; 95% CI=0.77–2.73;  $p=0.244$ ), there was no statistically significant difference in outcomes. Indeed, the use of a silicone stent and its duration have not been definitively demonstrated to be effective.

Some authors suggested that the use of mitomycin C (MMC), an aminoglycoside antibiotic with antineoplastic potential, may improve the success rates of END-DCR,<sup>40</sup> whereas other authors suggested that it does not influence outcomes.<sup>41–44</sup> Local instillation of MMC has no systemic side effects, but can cause conjunctival irritation, lacrimation, and punctate keratitis.<sup>45</sup>

Cheng et al. published a systematic review and meta-analysis reporting that MMC improves success rates in primary and revision END-DCR without silicone stenting, but no differences were noted in the subgroup of silicone intubation. For these reasons, we do not apply MMC during END-DCR.

Finally, many authors have suggested that correct timing for follow-up is fundamental as it can radically influence the surgical result:<sup>3,6</sup> in fact, periodic lacrimal pathway irrigation and scar tissue removal is an important aspect of post-operative follow-up. Moreover, some authors suggest that endoscopic nasal toilette, using a 30° rigid endoscope, is a possible clinical technique to obtain a functional rhinostomy after END-DCR because it allows removal of nasal granulation tissue, scars, and pathological secretions.<sup>3</sup>

In conclusion, this retrospective case series confirms that END-DCR is one of the most successful types of surgery in treatment of NLDO. It is important to emphasize that meticulous endoscopic surgery and precise follow-up are key factors in obtaining anatomical and functional patency of the nasal rhinostomy in the long term.

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