

# Long-Term Outcomes of External Dacryocystorhinostomy with U-Flap and Nasolacrimal Intubation in Adult Patients with Small Lacrimal Sac and Primary Nasolacrimal Duct Obstruction

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## SUMMARY

**Aim:** To report long-term postoperative outcomes of external dacryocystorhinostomy (Ext-DCR) with U-flap and nasolacrimal intubation in adult patients with small lacrimal sac and primary nasolacrimal duct obstruction (NLDO).

**Material and methods:** This case series was conducted in a tertiary health care center of North India and included 26 patients who underwent Ext-DCR with U-flap with nasolacrimal intubation for primary NLDO and small lacrimal sac from June 2021 to January 2024 with a minimum follow-up period of 12 months.

**Results:** Out of 26 patients, 22 were females with a mean age of 50 years (range 21–60). All patients had a history of purulent discharge from the affected eye. Excessive bleeding was the most common intraoperative challenge faced in most of the cases (6, 23%).

The intubation set was removed 12 weeks after surgery. Two female patients had tube-related complications in the form of granuloma formation, and two patients had tube retraction, one had slitting of the punctum, and another acquired an infection. The remaining 20 patients had an uneventful postoperative period. The outcomes of only 2 patients were reported as failures (8%), and the remaining 24 reported successful outcomes (92%) after 12 months of follow-up.

**Conclusion:** Ext-DCR with U-flap and nasolacrimal intubation is an effective procedure with a high long-term success rate in adult patients with a small lacrimal sac and primary NLDO.

**Key words:** external DCR, U-flap, nasolacrimal intubation, chronic dacryocystitis, small lacrimal sac

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## INTRODUCTION

Dacryocystitis refers to inflammation of the lacrimal sac, primarily caused by stenosis of the nasolacrimal duct that obstructs the tear drainage. The condition can be either acute or chronic. Acute dacryocystitis is typically caused by an acute infection of the lacrimal sac, with the *Staphylococcus* and *Streptococcus* species being the most common pathogens. The chronic form results from a prolonged obstruction of the nasolacrimal duct.

The treatment for acute dacryocystitis typically involves the use of systemic antibiotics, along with drainage of the lacrimal sac abscess, leading to relief of pressure and discomfort in the lacrimal sac and evacuating the abscess

cavity. However, the treatment of choice remains surgical, especially Ext-DCR, performed after the resolution of acute infection. It is a procedure to restore a functional channel between the lacrimal sac and the nasal cavity. It involves opening the nasolacrimal sac and performing an osteotomy to ensure proper drainage. Ext-DCR is an effective treatment for primary acquired nasolacrimal duct obstruction, with a reported success rate ranging from 70% to 95% [1]. An appropriately sized, patent, and mucosa-lined anastomosis between the lacrimal sac and the nasal mucosa forecasts the success of Ext-DCR [2]. This can be achieved by creating an H-shaped incision in both the lacrimal sac and nasal mucosa, with an end-to-end anastomosis of the anterior and posterior mucosal flaps,

or by an alternative anterior flap Ext-DCR technique, including suturing of the U-shaped anterior flaps and total excision of the posterior flaps. Equal success rates have been reported for both techniques [2–4].

In a recent study, it was concluded that a small lacrimal sac was the only independent risk factor for functional failure of Ext-DCR in patients with primary NLDO [5]. Furthermore, some researchers have reported that lacrimal sac size could be a predicting factor for the anatomical success of endonasal DCR; that is, patients with a large sac on preoperatively dacryocystography had significantly higher success rates than those with a small lacrimal sac [6,7].

To date, the causal link between lacrimal sac size and Ext-DCR functional failure is still to be explored. Silicone tube insertion may aid in facilitating tear flow through capillary action in individuals with cicatrized and constricted lacrimal sacs, which can impact hydrostatic pressure transmission. The silicone tubing serves as a temporary stent, preserving patency during the healing process of the surrounding tissues [8]. Hurwitz asserted that the introduction of tubes through the pathology associated with the NLDO does not mitigate or bypass the fundamental process and recommended a prolonged follow-up period to ensure the success [9]. However, the long-term outcomes of nasolacrimal intubation (NLI) in patients with small lacrimal sacs and primary NLDO are still underexplored.

Therefore, this study aims to evaluate the long-term postoperative outcomes of Ext-DCR with U-flap and NLI in adult patients with primary NLDO and a small lacrimal sac.

## MATERIAL AND METHODS

This study adhered to the principles outlined in the Declaration of Helsinki, as approved by the Institutional Ethics Committee (AIIMS/IEC/25/1, dated 15/01/2025), and was conducted at a tertiary care hospital in North India. Medical records of all adult patients who underwent Ext-DCR with NLI for primary NLDO by a single surgeon (AS) from June 2021 to January 2024 were reviewed. A total of 26 patients aged over 18 years with primary NLDO who underwent Ext-DCR with NLI and had a small lacrimal sac intraoperatively were included, after obtaining written informed consent. Patients with a history of trauma, secondary nasolacrimal duct obstruction, bony deformities, punctal stenosis, eyelid deformities, previous eyelid and/or lacrimal surgery, canalicular obstruction, eyelid malposition, nasal or lacrimal drainage system tumors, and follow-up of less than 1 year were excluded.

All patients underwent a thorough ophthalmic examination, and the diagnosis of NLDO was based on a history of tearing or discharge and regurgitation on pressure over the lacrimal sac, diagnostic probing of the upper lacrimal drainage system, and irrigation of the nasolacrimal

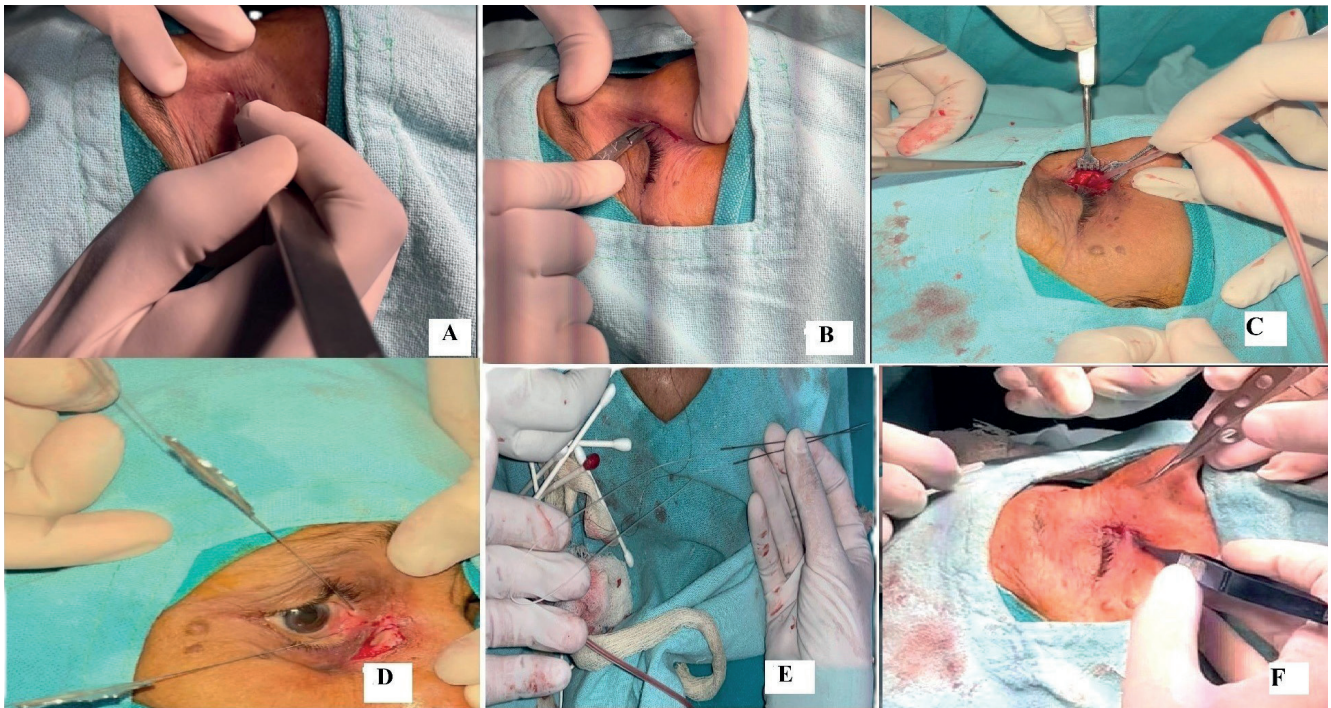
duct. Patients with reflux of fluid through the opposite canaliculus on irrigation and the hard stop on diagnostic probing, without common canalicular membranous stenosis, were included [10].

The size of the lacrimal sac was labeled as small ( $\leq 5$  mm), moderate (5–10 mm), and large ( $> 10$  mm) by measuring the vertical height of the cavity, created by making a vertical incision on the medial wall of the lacrimal sac intraoperatively [5]. The final diagnosis was determined based on the intraoperative confirmed site of obstruction. Only those patients who had small lacrimal sacs and primary NLDO without any other nasal or bony abnormalities were included in the final analysis.

All procedures were performed under monitored or general anesthesia. After anesthetic induction, the nasal cavity on the side to be operated on was packed with gauze soaked in 2% xylocaine jelly and 1:100,000 adrenaline. After local infiltration of 1–2 cc lidocaine-adrenaline 1:200,000, a 14–16 mm curvilinear skin incision was made with a 15 mm blade over the anterior lacrimal crest, ensuring the angular vein was avoided. After blunt dissection of the orbicularis oculi muscle fibers, the medial canthal ligament was reached and was partially cut if required to facilitate access. The periosteum along the anterior lacrimal crest was incised and reflected anteriorly using a blunt periosteal elevator, and the lacrimal sac was displaced laterally. The lacrimal crest was visualized, and the anterior lacrimal crest was removed to gain access to the nasolacrimal duct. A 10 x 12 mm bony window was created using a Kerrison punch, taking care not to damage the nasal mucosa. The bony rhinostomy was enlarged using 2mm and 3mm Kerrison bone punches, until the bone of the lacrimal fossa and part of the anterior lacrimal crest were removed. Thereafter, an anteriorly based U-shaped nasal mucosa flap was created, using a scalpel with an 11 mm blade.

After the dilatation of the superior and inferior puncta, the canalicular ducts were probed.

The medial wall of the lacrimal sac was tented with a 00 Bowman's Lacrimal Probe. Next, a vertical incision was made in the medial wall of the lacrimal sac, using a scalpel with an 11 mm blade in a sagittal plane medially of the common canalicular duct, and the cavity was measured. In cases with cavities measuring less than 5mm, bicanalicular NLI was performed, using a silicone lacrimal intubation set (Aurolab, Langenhagen, Germany), after excising the posterior remnant of sac. The remaining part of the anterior lacrimal sac wall was sutured to the U-shaped nasal mucosa flap, using two 6-0 Vicryl® (Polyglactin 910) sutures, after tenting it with the periosteum. (Figure 1A–F) The deep orbicularis layer was finally closed with 6-0 Vicryl (Polyglactin 910) sutures, and the skin was closed with intermittent 6-0 Prolene (polypropylene) sutures. The nasal ends of the silicone tubes were sutured and secured with the ala of the nose with a 4-0 silk suture. Nasal packing was done with an adrenaline-soaked pack. The wound was covered with a double layer of sterile dressing.



**Figure 1.** External DCR technique. (A) A curvilinear incision made on skin (14–16mm) over anterior lacrimal crest. (B) Careful, meticulous dissection was done to expose the lacrimal sac. (C) Kerrison bone punch is used to create an osteotomy. (D) Probing was done to tent the lacrimal sac so that a flap can be raised easily. (E) A bicanalicular nasolacrimal intubation tube was prepared after making a nasal mucosal flap. (F) After performing NLI, the lacrimal and nasal mucosal flaps were sutured with a 6-0 Vicryl suture  
*DCR – dacryocystorhinostomy, NLI – nasolacrimal intubation*

Postoperatively, steroid-antibiotic eyedrops were applied 4 times daily for 2 weeks. Patients were followed up after 1 week, 1, 3, 6, and 12 months. The stent was removed at 12 weeks (3<sup>rd</sup> month). Patients were asked to come for follow-up in the case of discharge, epiphora, or any other complaints after the initial follow-up.

Complete disappearance of the symptoms was considered a success, and improvement in symptoms with some residual symptoms was considered a partial success. No improvement or worsening of symptoms was labeled as a failure. Data were entered and studied using Microsoft® Excel® 2021 MSO (Version 2501), which included preoperative baseline characteristics of the patients, intraoperative complications encountered, postoperative course, success, and failure after 12 months of follow-up.

## RESULTS

In our study, a total of 26 patients were included, consisting of 22 females and 4 males. The mean age of the participants was 50 years, with ages ranging from 21 to 60 years. The baseline data have been summarized in Table 1.

The most common intraoperative complication was bleeding, encountered in 6 patients. Most patients (20 out of 26) had an uneventful postoperative course (Table 2). Postoperatively, two female patients developed tube-related complications in the form of granuloma formation, leading to failure of the procedure. Two other patients

**Table 1.** Demographic and baseline characteristics of study participants

	Total	Percentage
<b>Sex</b>		
Male	4/26	15%
Female	22/26	85%
<b>Age</b>		
18–60Y	20/26	77%
> 60Y	6/26	23%
<b>Lateralization</b>		
Right	19/26	73%
Left	7/26	27%
<b>Duration of Symptoms (months)</b>		
0–12	7/26	27%
13–24	2/26	8%
24–36	14/26	54%
> 36	3/26	11.5%
<b>Diagnostic Probing</b>		
NLDO	26/26	100%

*NLDO – nasolacrimal duct obstruction*

experienced tube retraction, which was managed and removed in the Outpatient Department with the assistance of an Otorhinology (ENT) consultation. One patient had slitting of the lower punctum due to NLI, and another patient

**Table 2.** Intra-operative and post-operative outcomes

	Total	Percentage
<b>Mean Operative Time</b>	57.3 minutes	
<b>Time of tube removal (wks)</b>		
> 12 weeks	24/26	92%
Displaced at 10 weeks	2/26	8%
<b>Follow Up Time (months)</b>		
12–18	12/26	46%
18–24	11/26	42%
> 24	3/26	11.5%
<b>Intraoperative complications</b>		
Small Lacrimal Sac	26/26	100%
Excess Bleeding	6/26	23%
<b>Post-operative Complications</b>		
Granuloma formation	2/26	8%
Tube retraction	2/26	8%
Slitting of the punctum	1/26	4%
Infection	1/26	4%
<b>Long-term final outcome</b>		
Complete success	20/26	77%
Partial success	4/26	15%
Failure	2/26	8%

acquired an infection, requiring a course of intravenous antibiotics in the postoperative period. Overall, 20 patients reported complete disappearance of symptoms, 4 had significant improvement in symptoms, with some residual symptoms in the form of occasional watering, and 2 did not have any improvement in symptoms. Thus, 20 patients had a successful outcome, 4 had partial success, and 2 had a failure. Therefore, the long-term success rate of the procedure was 92% (including success and partial success cases).

## DISCUSSION

DCR surgery creates an anastomosis between the lacrimal sac mucosa and the nasal mucosa after the resolution of the acute phase of dacryocystitis. Females are more prone to nasolacrimal duct obstruction than males, largely due to their narrower lacrimal fossa.

Our findings align with the existing literature that females, particularly those with narrower lacrimal fossa, are more prone to nasolacrimal duct obstruction, with our study group showing a preponderance of 22 females out of 26 cases. The mean age of the participants was 50 years, which correlates with the age range typically associated with primary acquired nasolacrimal duct obstruction, often seen in middle-aged adults.

Ext-DCR has been the gold standard surgical technique for treating primary acquired nasolacrimal duct obstruction

since it was first described by Toti in 1904 [11]. Its success is attributed to the ability to directly visualize the anatomy, which facilitates precise anastomosis between the lacrimal sac and the nasal mucosa. This direct visualization of the surgical field has been crucial in minimizing complications, ensuring effective drainage, and reducing the risk of postoperative stenosis. Despite its established success, the advent of endonasal DCR has raised interest due to its benefits, including no external scarring [11] and shorter operating times. However, recent studies have indicated that endonasal DCR often produces poorer outcomes compared to external DCR, probably due to the difficulty in maintaining the necessary anatomical precision and difficulty in visualizing the surgical site. In addition, recent research has shown that patient satisfaction with the Ex-DCR scar is very high (97%), with the majority considering the scar invisible [12,13].

In our study, we utilized the single-flap technique (U-shaped flap) rather than the traditional double-flap technique (H-shaped flap). The U-flap technique offers several advantages over the H-flap method. It allows for more precise and accurate flap creation, easier manipulation, as the surgeon has a clearer visual guide during the incision and flap formation [14]. Additionally, the U-flap generally requires fewer surgical steps, which leads to a shorter operative time [14] and might be easier to raise in small lacrimal sacs.

However, the U-shaped flap does have some disadvantages, particularly the risk of sagging, which can be prevented by tenting the flap to the adjacent periosteum. On the other hand, the H-shaped flap minimizes the chances of exposing bone, which could promote better healing at the stromal site, prevent the formation of granulation tissue, and facilitate epithelization.

In our study, we included only adult patients with primary NLDO with small lacrimal sacs. As small lacrimal sac was found to be the only independent risk factor for functional failure of Ext-DCR in patients in recent literature [5], we opted for NLI in all patients with U-shaped flaps. However, NLI, although not essential in every instance, was executed in all study participants, to avert postoperative stenosis due to a lacrimal sac measuring  $\leq 5$  mm and to promote healing, thus diminishing the necessity for reoperation. A U-shaped flap was made, keeping in mind easier manipulation in small sacs.

Nevertheless, like other procedures, NLI is also not without its downsides. Many authors have reported complications, such as punctal slitting, tube retraction, infection, corneal abrasion, breakage, and retention of the tube after severance of the canthal loop [10].

The postoperative course was uneventful in most of the patients in our case series (20), except for two patients who had granuloma due to the stent, stent retraction in another two; slitting of the lower punctum, and infection respectively were noticed in another two patients. The overall surgical failure rate for Ext-DCR with NLI in our study was 8% due to granuloma formation, which is very low.

A key aspect of this study was the use of the single U-shaped flap technique, which we found to be advantageous over the more traditional double H-shaped flap technique. We found it simpler, requiring fewer steps, and more convenient in small lacrimal sacs.

Baldeschi et al. [14] demonstrated that successful anastomosis could be achieved with broad, movable anterior flaps without suturing the posterior flaps, which resulted in a 100% success rate. Elwan [15] stated that suturing had an 85% success rate, and posterior flap excision had a 90% success rate. According to Serin et al. [16], the success rate for resection was 96.67%, whereas the success rate for posterior flap anastomosis was 93.75%. In our study, we found that performing a U-shaped flap resulted in a high rate of success (92%), despite a few postoperative complications.

With regard to postoperative management, we used nasolacrimal intubation in a few cases, to reduce the risk of postoperative stenosis and to improve the chances of a successful functional outcome. While not required in every case, silicone intubation has been shown to aid lacrimal pump function and drainage, thereby reducing epiphora in cases where anatomically successful surgeries failed functionally. This was supported by Kim et al. [17], who demonstrated that silicone intubation helped to restore drainage in cases with anatomically successful but functionally unsuccessful DCR.

Our study encountered a few complications: intraoperative bleeding was the most common, although this did not significantly impact the overall success rate. Postoperatively, two female patients developed granulomas around the silicone tubes, while another two experienced

tube retraction, requiring consultation with the ENT team for removal. The overall surgical failure rate in our study was 8%, which is comparable to the failure rates reported in the literature for external DCR. None of the patients reported any dissatisfaction regarding the scar, which was almost invisible after a few months of follow-up.

There are limitations in this study, including retrospective design, the small sample size, and the lack of a control group comparing the single U-shaped flap to the double H-shaped flap technique, and subgroups with and without NLI. A larger sample size and a more comprehensive analysis would assist in further validating the findings and in exploring the distinctions of surgical outcomes between these two flap techniques. Dacryocystography or lacrimal scintigraphy, and the dye disappearance test were not performed preoperatively, adding to the limitations.

## CONCLUSION

To the best of our knowledge, this is the only study to report long-term outcomes of Ext-DCR with U-flap and NLI in adult patients with primary NLDO and a small lacrimal sac.

Therefore, we can conclude that Ext-DCR with U-flap and NLI is an effective and promising procedure, with a high, long-term success rate in adult patients with small lacrimal sacs and primary NLDO. In view of the minimal tube-related adverse outcomes, we recommend NLI in all patients of primary NLDO with a small lacrimal sac. However, a prospective study with a large sample size is warranted to confirm the study findings.

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