

## Anatomical Success Is Not Functional Success: Predictors of Outcome After Endoscopic Dacryocystorhinostomy in 110 Patients

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### Abstract

**Background:** Endoscopic Dacryocystorhinostomy (eDCR) is an established treatment for nasolacrimal drainage obstruction and provides high anatomical success rates. However, restoration of ostium patency does not invariably translate into resolution of epiphora. Understanding the discrepancy between anatomical and functional outcomes is therefore essential to optimize patient selection and surgical expectations.

**Objective:** To evaluate the outcomes of endoscopic dacryocystorhinostomy in a consecutive single-centre series and identify preoperative, intraoperative, and postoperative factors associated with surgical and functional failure.

**Methods:** We retrospectively reviewed 110 patients undergoing endoscopic dacryocystorhinostomy with bicanalicular silicone intubation between January 2014 and February 2024. Surgical outcome was assessed using both symptomatic resolution and postoperative endoscopic evidence of ostium patency. Potential predictors included demographic characteristics, medical comorbidities, level of lacrimal obstruction, selected surgical variables, postoperative ostium findings, and associated ocular adnexal abnormalities.

**Results:** The overall anatomical success rate was 87%. Among failed procedures, an identifiable anatomical obstruction was visualized endoscopically in 86%, whereas 14% showed no demonstrable anatomical obstruction. Importantly, 18.9% of anatomically successful cases remained functionally unsuccessful, demonstrating a clinically relevant dissociation between anatomical patency and symptomatic relief.

Older age and diabetes mellitus were significantly associated with functional outcome ( $P=0.024$  and  $P=0.008$ , respectively). Sex, laterality, hypertension, uncinectomy, middle turbinectomy, ostium granulation, membranous obstruction, and intranasal synechiae were not significantly associated with functional outcome ( $P>0.05$ ). Eyelid laxity and conjunctivochalasis were frequent among patients with persistent symptoms despite anatomical patency. More proximal lacrimal obstruction was also associated with poorer functional prognosis.

**Conclusion:** Endoscopic DCR provides favorable anatomical outcomes, but anatomical patency should not be considered synonymous with clinical cure. Persistent epiphora despite a patent ostium represents a distinct failure phenotype influenced by patient-related and lacrimal-pump factors. Advanced age, diabetes mellitus, proximal obstruction, and ocular adnexal abnormalities deserve particular consideration during preoperative evaluation. Successful lacrimal surgery should therefore be defined by restoration of functional tear drainage rather than ostium patency alone.

**Keywords:** Endoscopic dacryocystorhinostomy; Epiphora; Nasolacrimal duct obstruction; Functional failure; Anatomical success; Prognostic factors; Lacrimal drainage; Silicone intubation

## Introduction

Nasolacrimal drainage obstruction is a common cause of persistent epiphora and recurrent dacryocystitis and may substantially impair vision-related activities and quality of life. Dacryocystorhinostomy (DCR) restores lacrimal drainage by creating a direct communication between the lacrimal sac and the nasal cavity, thereby bypassing the obstructed nasolacrimal duct [1–3].

Although external DCR was historically considered the reference surgical procedure, advances in endoscopic visualization, instrumentation, powered surgery, and understanding of intranasal lacrimal anatomy have established endoscopic dacryocystorhinostomy (eDCR) as an effective alternative [1–4]. The endonasal approach avoids a cutaneous scar, preserves the medial canthal structures and orbicularis oculi pump, permits simultaneous management of selected intranasal abnormalities, and provides direct visualization of the rhinostomy during postoperative follow-up [2–5].

Modern eDCR series generally report high success rates, frequently exceeding 85–90% [1–6]. However, comparison between studies is complicated by substantial heterogeneity in the definition of surgical success. Some authors define success anatomically, according to ostium patency or lacrimal irrigation, whereas others prioritize resolution of epiphora or patient-reported improvement [1,3,6].

This distinction is clinically fundamental.

A technically patent rhinostomy does not necessarily restore effective tear drainage. Persistent or recurrent epiphora may occur despite successful anatomical bypass of the nasolacrimal duct, a condition commonly referred to as functional failure after DCR [7–10]. Previous multicenter experience suggests that a clinically relevant proportion of patients continue to experience epiphora despite an anatomically successful procedure [7].

The mechanisms underlying this anatomical-functional dissociation remain incompletely understood. Effective tear drainage is a dynamic process requiring coordinated punctal apposition, canalicular patency, eyelid tone, orbicularis-mediated lacrimal pumping, adequate lacrimal sac and ostium geometry, and normal ocular-surface tear production. Consequently, abnormalities outside the surgically created ostium may compromise functional outcome despite technically successful surgery [7–11].

Multiple factors have been investigated as potential predictors of DCR failure, including age, diabetes mellitus, level of lacrimal obstruction, previous surgery, lacrimal sac characteristics, silicone intubation, intranasal anatomy, granulation, cicatricial ostium closure, synechiae, and eyelid abnormalities [6,8–15]. Evidence remains heterogeneous, however, and relatively few studies have simultaneously distinguished anatomical from functional failure.

The present study analyzes outcomes after 110 endoscopic DCR procedures performed over a 10-year period, with particular emphasis on patients who remained symptomatic despite anatomical patency.

Our primary objective was to identify factors associated with poor functional outcome after eDCR. A secondary objective

was to characterize the discrepancy between anatomical and functional success and determine whether conventional ostium-centered assessment adequately reflects patient-perceived surgical success.

## Materials and Methods

**Study Design and Population:** We conducted a retrospective observational study including 110 patients undergoing endoscopic dacryocystorhinostomy between January 2014 and February 2024.

Patients underwent eDCR for lacrimal drainage obstruction and were evaluated using available preoperative, intraoperative, and postoperative clinical data.

**Surgical Technique:** Endoscopic dacryocystorhinostomy was performed through an endonasal approach.

A rhinostomy providing communication between the lacrimal sac and nasal cavity was created, and bicanalicular silicone lacrimal intubation was used in the study cohort.

Additional intranasal procedures, including uncinectomy or middle turbinate surgery, were performed when indicated according to individual anatomy and operative requirements.

**Outcome Assessment:** Two complementary outcomes were considered.

**Anatomical success:** Anatomical success was defined by postoperative evidence of patency of the surgically created lacrimal drainage pathway, including endoscopic assessment of the rhinostomy.

**Functional success:** Functional success was defined by satisfactory resolution of lacrimal symptoms, particularly epiphora.

Patients with a patent postoperative ostium but persistent symptoms were therefore classified as having:

### **Functional failure despite anatomical success:**

This distinction constituted a central endpoint of the study.

### **Variables Evaluated:**

Potential determinants of outcome included:

- age;
- sex;
- laterality;
- diabetes mellitus;
- hypertension;
- site/level of lacrimal obstruction;
- duration of symptoms;
- uncinectomy;
- middle turbinectomy;
- silicone intubation-related variables;
- postoperative ostium granulation;
- membranous obstruction;
- intranasal synechiae.

In patients with anatomical success but persistent functional symptoms, associated ocular adnexal abnormalities were additionally evaluated, particularly:

- eyelid laxity;
- conjunctivochalasis;
- punctal eversion.

### **Statistical Analysis:**

Associations between demographic, clinical, surgical, and postoperative variables and functional outcome were assessed. A P value <0.05 was considered statistically significant.

Given the limited number of functional-failure events, analyses were primarily univariable; exploratory multivariable assessment was restricted to a small number of clinically preselected variables and its results are reported as hypothesis-generating rather than confirmatory.

## Results

### Overall Surgical Outcome:

The overall anatomical success rate after endoscopic DCR was 87%.

Conversely, approximately 13% of procedures were classified as anatomical failures.

Among failed procedures, postoperative endoscopy allowed identification of an anatomical cause of obstruction in 86%.

In the remaining 14%, persistent symptoms occurred without demonstrable anatomical obstruction.

This latter group already suggested that postoperative epiphora could not invariably be explained by simple rhinostomy closure.

### Anatomical Success Versus Functional Success:

The most clinically important finding emerged when anatomically successful procedures were analyzed separately.

Despite documented anatomical patency, 18.9% of anatomically successful cases did not achieve functional success.

Thus, almost one fifth of patients with an anatomically successful procedure continued to experience symptoms.

This observation demonstrates that anatomical and functional success represent related but non-equivalent endpoints after eDCR.

### Patient-Related Predictors of Functional Outcome:

Age was significantly associated with functional outcome.

Patients in the functional-failure group were older than those achieving both anatomical and symptomatic success ( $P=0.024$ ).

Diabetes mellitus was also significantly more prevalent among patients with functional failure ( $P=0.008$ ).

In contrast, no significant association with functional outcome was identified for:

- sex;
- laterality;
- hypertension.

### Surgical and Postoperative Factors:

Several conventional surgical and postoperative parameters were not significantly associated with functional outcome.

These included:

- uncinectomy;
- middle turbinectomy;
- ostium granulation;
- membranous obstruction;
- intranasal synechiae.

All demonstrated  $P>0.05$  in the available analysis.

These observations suggest that persistent symptoms in patients with an open ostium may be driven more strongly by factors beyond the rhinostomy itself.

### Ocular Adnexal Abnormalities in Functional Failure:

Among anatomically successful but functionally unsuccessful patients, associated abnormalities of the eyelid and conjunctiva were frequently observed.

The two most frequent conditions were:

### Eyelid laxity and conjunctivochalasis:

Punctal eversion was also identified in a subset of patients.

These findings were particularly relevant among older patients.

### Level of Lacrimal Obstruction:

The anatomical level of lacrimal obstruction influenced prognosis.

More proximal obstruction was associated with poorer functional outcome, supporting the importance of the entire lacrimal drainage pathway rather than the distal nasolacrimal duct alone.

### Multivariable Findings:

The source analysis identified advanced age and proximal location of lacrimal obstruction as adverse prognostic characteristics.

In contrast, symptom duration and stent-related parameters were not demonstrated to be independent determinants of poor prognosis.

## Discussion

The present study highlights a clinically important limitation of conventional outcome assessment after endoscopic dacryocystorhinostomy: an anatomically successful DCR is not necessarily a functionally successful DCR.

In this series of 110 patients, anatomical success was achieved in 87%, confirming the overall effectiveness of eDCR. More importantly, however, 18.9% of anatomically successful procedures remained functionally unsuccessful.

This finding shifts the focus of DCR outcome assessment from a purely surgical question—whether the rhinostomy remains open—to a more clinically relevant question: whether effective tear drainage has actually been restored.

### Anatomical success is not synonymous with clinical cure:

Success rates reported after eDCR vary substantially according to the endpoint used.

A systematic review by Leong et al. demonstrated generally favorable results after DCR but also emphasized considerable heterogeneity among studies in surgical technique and definitions of success [1]. Modern series similarly report success rates commonly between approximately 82% and 98%, depending on patient selection and outcome criteria [6].

The 87% anatomical success rate observed in our cohort therefore falls within the expected range of published experience. However, anatomical success alone overestimates patient-perceived benefit.

Shams et al. specifically evaluated persistent epiphora after anatomically successful DCR and estimated that approximately 5–10% of patients may continue to experience tearing despite a patent lacrimal pathway [7]. Their multicenter study demonstrated that functional epiphora represents a genuine postoperative entity rather than simply undetected ostium closure. Our observed proportion of functional failure was higher, reaching 18.9% among anatomically successful cases.

Interestingly, Sung et al. reported exactly the same magnitude—18.9% functional failure among anatomically successful eDCR procedures—in their analysis of the effect of age on surgical outcomes [8]. Their study also identified older age and

diabetes mellitus as significant correlates of functional failure, strongly supporting the biological and clinical relevance of these factors.

### **Why can an open DCR remain symptomatic?**

Tear drainage is not a passive phenomenon.

Anatomical patency permits tears to reach the nasal cavity, but efficient transport depends on a coordinated lacrimal pump.

Blinking generates complex pressure changes through contraction and relaxation of the orbicularis oculi muscle, while appropriate punctal positioning and eyelid-globe apposition permit tears to enter the canalicular system.

Consequently, a patient can have an entirely patent rhinostomy while remaining symptomatic because the pathway is open but functionally inefficient.

This concept provides a plausible explanation for the ocular adnexal abnormalities observed in our functionally unsuccessful patients.

### **Age as a determinant of functional failure:**

Older age was significantly associated with functional failure in our cohort ( $P=0.024$ ).

Age-related changes can affect virtually every component of the lacrimal drainage mechanism, including eyelid tone, punctal position, conjunctival anatomy, blink efficiency, and ocular surface homeostasis.

Sung et al. found that although anatomical success did not significantly differ between younger and older groups, functional success was significantly lower among older patients [8]. Older patients with functional failure also exhibited a greater prevalence of eyelid laxity.

Similarly, studies of DCR in elderly populations have suggested that anatomical success may remain high while symptomatic resolution becomes less predictable [11].

These findings suggest that age should not be considered a contraindication to eDCR. Rather, advanced age should trigger a more comprehensive preoperative functional assessment.

### **Eyelid laxity and conjunctivochalasis: overlooked determinants?**

Our observation of frequent eyelid laxity and conjunctivochalasis among patients with functional failure is particularly important.

Eyelid laxity can reduce the efficiency of the lacrimal pump and alter punctal apposition.

Conjunctivochalasis may mechanically interfere with tear flow toward the punctum and can itself produce epiphora through ocular-surface irritation.

Consequently, persistent tearing following DCR may reflect an incorrect assumption that all preoperative epiphora originated exclusively from nasolacrimal duct obstruction.

Preoperative examination should therefore extend beyond lacrimal irrigation.

In elderly patients in particular, careful evaluation should include eyelid position and tone, punctal position, conjunctivochalasis, ocular surface status, and blink dynamics.

### **Diabetes mellitus and functional outcome:**

Diabetes mellitus was significantly associated with functional failure ( $P=0.008$ ).

This association has also been reported by Sung et al. [8].

Several mechanisms are biologically plausible, including microvascular dysfunction, impaired wound healing, chronic low-grade inflammation, altered epithelial repair, neuropathy,

and age-related confounding.

However, because diabetes prevalence increases with age, its independent contribution is difficult to establish without comprehensive multivariable adjustment.

Accordingly, our findings support diabetes as a risk marker, but they should not be interpreted as demonstrating a direct causal mechanism.

### **Level of obstruction matters:**

Another important observation concerns the anatomical level of lacrimal obstruction.

More proximal obstruction was associated with poorer functional prognosis.

This is consistent with the large study by Lee et al., which evaluated 769 external DCR procedures. Although anatomical success reached 98.8%, functional success was only 81.9%. Common canalicular obstruction increased the risk of functional failure by approximately 75%, while canalicular obstruction approximately doubled the risk [9].

These results are physiologically logical.

DCR is exceptionally effective at bypassing distal nasolacrimal duct obstruction, but it cannot fully compensate for impaired tear entry or transport through the canalicular system.

Thus, the more proximal the dysfunction, the less likely creation of a distal bypass alone is to restore normal tear drainage.

### **Surgical factors versus patient factors:**

An intriguing feature of our results is the lack of significant association between functional outcome and several technical variables, including uncinctomy, middle turbinectomy, granulation, membranous obstruction, and intranasal synechiae.

This does not imply that surgical technique is unimportant.

On the contrary, technical failure remains a major cause of anatomical failure.

Recent analysis of revision eDCR has shown that inadequate lacrimal sac exposure, cicatricial closure of the ostium, and synechiae are prominent findings in failed procedures [12].

The distinction is therefore essential:

technical factors may primarily determine whether the rhinostomy remains anatomically patent, whereas patient-related factors may become increasingly important in determining whether an anatomically successful operation is also functionally successful.

### **The role of silicone intubation:**

Silicone intubation remains one of the most debated aspects of eDCR.

A systematic review and meta-analysis of 12 randomized controlled trials encompassing 1,239 procedures reported an overall eDCR success rate of 91.9% and found no statistically significant difference between stented and non-stented procedures [13].

More recent evidence continues to examine this question, with differences according to endpoints and patient selection [14].

Our cohort underwent bicanalicular silicone intubation, but the available analysis did not demonstrate stent-related parameters as independent determinants of poor functional outcome.

This supports the concept that stenting cannot correct dysfunction originating from the eyelid, punctum, canalicular pump, or ocular surface.

### **A clinically useful classification of DCR failure:**

Our findings support separating postoperative failure into two major phenotypes.

### **Type I — Anatomical failure:**

This includes:

- ostium closure;
- cicatricial stenosis;
- inadequate sac exposure;
- granulation;
- membranous obstruction;
- synechiae;
- canalicular obstruction.

In this phenotype, revision surgery directed at restoring anatomical patency may be appropriate.

### **Type II — Functional failure despite anatomical success:**

This includes persistent epiphora despite a patent ostium and may be associated with:

- eyelid laxity;
- impaired lacrimal pump;
- punctal malposition;
- conjunctivochalasis;
- proximal canalicular dysfunction;
- ocular surface abnormalities;
- excessive tear production.

In this second phenotype, simply enlarging an already patent rhinostomy may fail to address the actual mechanism of tearing.

This distinction has direct therapeutic consequences.

### **Toward patient-centered assessment of DCR success:**

Traditional surgical studies frequently define success according to endoscopic ostium visualization or lacrimal irrigation.

These remain indispensable measures of technical success, but they should not constitute the sole endpoint.

A more clinically meaningful postoperative evaluation should integrate:

1. anatomical ostium patency;
2. lacrimal irrigation or functional drainage testing;
3. patient-reported epiphora;
4. eyelid and punctal examination;
5. ocular-surface assessment;
6. need for additional lacrimal procedures.

Such a framework would distinguish technical success from patient success.

Our findings therefore argue for a conceptual transition from an ostium-centered model of DCR outcome toward a lacrimal-system-centered model.

### **Clinical Implications:**

The results of this study have several practical implications.

First, elderly patients should undergo systematic assessment for eyelid laxity, punctal abnormalities, and conjunctivochalasis before eDCR.

Second, the anatomical level of obstruction should be clearly characterized because proximal disease may predict poorer functional benefit.

Third, diabetes mellitus should be considered when counseling patients regarding postoperative expectations.

Fourth, persistent epiphora after eDCR should not automatically be interpreted as restenosis.

Before revision surgery, the surgeon should determine whether the primary procedure has failed anatomically or functionally. This distinction may prevent unnecessary revision of an already patent rhinostomy.

### **Strengths:**

A strength of this study is the consecutive nature of the series, comprising 110 endoscopic DCR procedures performed over a 10-year period at a single tertiary referral centre with a uniform surgical protocol.

Another important strength is the deliberate distinction between anatomical and functional outcomes.

Rather than considering ostium patency alone, our analysis explores why some technically successful procedures remain clinically unsuccessful.

The evaluation of demographic, systemic, intranasal, lacrimal, and ocular adnexal factors further provides a multidimensional assessment of surgical outcome.

### **Limitations:**

Several limitations should be acknowledged.

First, the retrospective design introduces potential selection and information biases.

Second, standardized quantitative patient-reported epiphora scores were not available in the source dataset.

Third, detailed quantitative measurements of postoperative ostium size and dynamic lacrimal pump function were unavailable.

Fourth, several associations may be confounded by age, particularly diabetes mellitus and eyelid laxity.

Fifth, the available dataset does not provide all adjusted odds ratios and 95% confidence intervals required to construct a formal predictive model.

Finally, the sample size of 110 patients limits statistical power, particularly for the subgroup of anatomically successful procedures in which functional failure was assessed; non-significant associations should therefore be interpreted as inconclusive rather than as evidence of absence of effect, and the reported proportions carry correspondingly wide confidence intervals. Future prospective studies should combine standardized anatomical assessment with validated epiphora scores, objective functional drainage testing, detailed eyelid examination, and multivariable predictive modeling.

### **Conclusion**

Endoscopic dacryocystorhinostomy provides favorable anatomical outcomes, with an overall anatomical success rate of 87% in this series of 110 patients.

However, the most important finding of this study is that 18.9% of anatomically successful procedures remained functionally unsuccessful.

Advanced age, diabetes mellitus, proximal lacrimal obstruction, eyelid laxity, and conjunctivochalasis emerged as clinically relevant characteristics associated with or potentially contributing to poor functional outcome.

These results demonstrate that ostium patency alone is an incomplete measure of DCR success.

Persistent epiphora following an anatomically successful procedure should prompt evaluation of the entire lacrimal functional unit—including the puncta, canaliculi, eyelids, lacrimal pump, conjunctiva, and ocular surface—before revision surgery is considered.

Ultimately, the goal of DCR should not merely be to create an open rhinostomy.

The goal should be to restore effective tear drainage and relieve the patient's symptoms.

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