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Impact of Posterior Mucosal Flap Management on Surgical Outcomes in Endoscopic Dacryocystorhinostomy: A Prospective Analysis

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ABSTRACT

Background: Endoscopic dacryocystorhinostomy is a highly effective procedure, increasingly becoming a standard for relieving epiphora and infections, with techniques evolving to improve success rates.
Objective: This study evaluated the effectiveness of endoscopic dacryocystorhinostomy (DCR) for the management of acquired nasolacrimal duct obstruction, comparing procedures that preserved posterior mucosal flaps with those that did not.
Methods: Prospectively, we examined the outcomes of 50 surgical procedures performed on 46 patients presenting with epiphora due to nasolacrimal duct obstruction at the Al-Nhada Special Surgical Center. The patients were assigned to one of two groups: group A received endonasal DCR with preservation of the posterior mucosal flap, and group B underwent the procedure with its removal.
Results: Among 50 procedures, Group A comprised 29 (58%) and Group B 21 (42%), including four bilateral cases. Overall subjective improvement was reported in 93.1% of patients. In group A, 94.1% showed patent rhinostomy on endoscopic follow-up at one month, with one obstruction; group B had two obstructions. Granulation tissue and synechia occurred in two patients in group A (one obstruction) and six in group B (two obstructions). No intraoperative complications were observed.
Conclusion: : Endoscopic techniques are a safe and effective treatment for nasolacrimal duct (NLD) obstruction. Our findings indicate no significant difference in surgical outcomes between endoscopic endonasal DCR performed with preservation of the mucosal flaps and without. Furthermore, the size of the created intranasal ostium did not correlate with its functional success.

Keywords: Endoscopic Dacryocystorhinostomy; Mucosal Flap; Nasolacrimal Duct Obstruction; Surgical Outcomes; Ostium.

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INTRODUCTION

Epiphora, or excessive tearing, results from an obstruction in the lacrimal drainage system. This blockage prevents tears from draining normally into the nasal cavity, which can lead to stagnation and recurrent infections [1]. The obstruction may be either congenital or acquired. Acquired cases often stem from age-related involutional changes, trauma, previous surgery, or neoplasms, and can progress to dacryocystitis [2].

Disorders of the nasolacrimal drainage system affect approximately 10-14% of individuals over 40 years old, with the prevalence rising to 40% by the age of 90 years [3]. Dacryocystorhinostomy (DCR) was the established surgical intervention for nasolacrimal duct obstruction (NLDO) when conservative measures fail [4]. Since its initial description by Caldwell in 1893 [5], DCR techniques and surgical approaches have continually evolved, yielding varying rates of success.

The endonasal approach for dacryocystorhinostomy (DCR) was initially limited by technical challenges such as restricted visualization and difficulty in removing bone and soft tissue, making the external approach the more prevalent choice for lacrimal bypass surgery [6]. The 1989 introduction of endoscopic transnasal DCR by McDonogh and Meiring marked a pivotal shift in this paradigm [7, 8]. Subsequent refinements, including the incorporation of lasers, have established endoscopic DCR as a robust technique. It was now substantiated by extensive literature demonstrating success rates equivalent to those of traditional external methods [9-12].

In 2002, Wormald introduced a technique for powered endoscopic DCR that involved fully exposing the lacrimal sac and performing a primary mucosal anastomosis [13]. Later reports supported the advantages and effectiveness of this method [14]. Evidence also seems to validate the theory that using a mucosal flap creates a larger and more durable surgical opening (ostium) [15].

It had been embraced that ostium scarring and stenosis were the main causes of DCR failure, whether through external or endoscopic methods [16]. Nevertheless, there was insufficient proof to conclude that direct anastomosis of mucosal flaps results in a noticeably larger ostium than other techniques. Moreover, there was no proof that the ostium's size and functional success were related [17]. As a result, many surgeons choose to let the surgical site heal through secondary intention rather than maintain mucosal flaps, a strategy that has shown promising clinical outcomes [18–20]. In this study, the surgical outcomes of endoscopic endonasal dacryocystorhinostomy (DCR) with posterior mucosal flap preservation were compared against those with mucosal flap removal.

METHODS

In this prospective study, 50 procedures were done in 46 patients who were admitted to Al-Nhada Special Surgical Center with epiphora caused by an obstruction of the nasolacrimal duct. The period of the study was conducted between November 2022 and October 2024. Those subjects underwent primary endoscopic endonasal DCR surgery and silicone tube stent; four cases with bilateral procedures were done. Patients were divided into either group A or group B.

Preoperative nasal endoscopic and ophthalmologic exams were performed on every patient. The two groups were distinguished by surgical technique: Group B underwent endonasal DCR with the posterior mucosal flap removed, while Group A underwent the surgery with it preserved. We recorded information on age, sex, operating side, use of powered instruments, septoplasty, surgical type, postoperative rhinostomy patency, and complications in order to compare surgical results between the groups.

Lacrimal irrigation was employed to detect nasolacrimal duct obstruction; all patients were having saline regurgitation through the opposing punctum, indicating flow resistance. To detect the pinpoint of the precise site of the obstruction, a diagnostic probing test was then carried out.

When the probe passes through the canaliculus and encounters the lacrimal bone's solid resistance, a "hard stop" was detected, signifying that the common canaliculus is patent. Additionally, when there is a blockage close to the lacrimal sac and the probe is unable to enter the sac, it causes a soft halt, which is a spongy sensation.

Inclusion Criteria

Patients were included if they met the following criteria:

1. Age between 5 and 75 years, presenting with persistent unilateral or bilateral epiphora or

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recurrent eye discharge due to nasolacrimal duct obstruction.
2. Demonstrated delayed regurgitation, with or without mucopurulent discharge, from the opposite punctum during lacrimal sac syringing.

Exclusion Criteria

Patients were excluded from the study for any of the following reasons:

1. Epiphora attributable to eyelid malposition (e.g., entropion, ectropion).
2. A probing test confirming common canalicular obstruction.
3. The procedure was a revision endonasal DCR.

All surgical procedures were conducted by two otorhinolaryngology specialists in collaboration with the referring ophthalmologist.

Ethical Considerations

This study was approved by Research and Ethics Committee, Faculty of Medicine and Health Sciences, University of Aden (Approval no. REC-152-2023). Prior to surgery, each participant gave their informed consent after being made aware of the goal of the study.

Surgical Techniques

All procedures were performed under general anesthesia. The initial step involved nasal decongestion, achieved by placing ribbon gauze soaked in 1:10,000 adrenaline in the middle meatus and between the inferior turbinate and nasal septum. The inferior turbinate was then carefully lateralized using a Freer dissector. Subsequently, a lidocaine solution containing 1:100,000 adrenaline was injected at the axilla of the middle turbinate and the lateral nasal wall overlying the frontal process of the maxilla. The surgery was conducted using both 0-degree and 30-degree endoscopes, each with a 4 mm diameter [21].

When access was impeded by a deviated septum, an endoscopic septoplasty was performed, with the septal incision made contralateral to the DCR side. The initial mucosal incision was created with a No. 15 scalpel blade. The incision pattern began approximately 8 mm superior to the middle turbinate's attachment, extending horizontally for 10 mm anterior to the turbinate. From this anterior point, a vertical incision descended to the midpoint of the middle turbinate and then continued posteriorly to the insertion of the uncinate process, remaining superior to the inferior turbinate's attachment.

A Freer periosteal elevator was then used to elevate a posteriorly based mucoperiosteal flap, which was reflected backward off the maxillary bone to the posterior dissection limit at the uncinate process. The key difference between the study groups was in the management of this flap: in Group A, the posterior mucosal flap was preserved, while in Group B, it was excised with scissors.

The inferior part of the lacrimal sac was visible after th e frontal process of the maxilla was removed using a Kerrison rongeur. In situations where there was a thick frontal process or dense lacrimal bone, a drill was used to thin the bone so that the superior sac could be fully exposed and the bone could be removed completely with the rongeur. To maximize surgical access, the agger nasi cell was also opened.

A metallic lacrimal probe was introduced medially through the superior and inferior canaliculi to tent the sac, providing a guide for incision. A vertical incision was then made with a sickle knife and extended superiorly and inferiorly.

A silicone stent was inserted via the upper and lower canaliculi in each instance, passed through the newly made rhinostomy and the opening of the lacrimal sac, and fastened inside the nasal cavity.

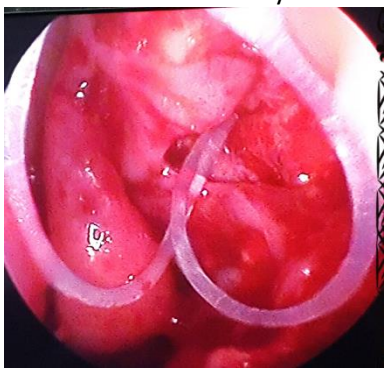

Figure 1: View obtained by 30 degree sinusope showing flap preservation

In Group A, anterior and posterior flaps were fashioned from the medial wall of the lacrimal sac. The elevated posterior nasal mucosal flap was then trimmed with microscissors and repositioned onto the lateral nasal wall. This allowed for end-to-end approximation of the

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lacrimal sac flaps with the nasal mucosal flap, as illustrated in (Figure 1).

In group B patients, the medial wall of the lacrimal sac was resected along with the mucosal covering flap. Small nasal packs were used for 6 hours postoperatively if the procedure was not associated with septoplasty; a bilateral septal splint and bilateral nasal pack were applied in cases with septoplasty, which were removed after two days and one week, respectively.

Systemic intravenous antibiotics, topical antibiotic eye drops for ten days, and a steroid nasal spray for one month were administered to each patient. Patients were released if there were no perioperative problems after a six-hour observation period. All patients underwent saline irrigation on the second postoperative day in order to eliminate fibrin clots and crusts.

The second visit was after one week, and then follow-up examinations of the patients were performed 1, 3, and 6 months after surgery. One month post-operation, an irrigation test was performed to assess the rhinostomy's patency, and a calibrated flexible suction tube was used to quantify its dimensions. If the size of the neo-ostium is more than 4 mm in width, it is considered anatomically patent; if less than 4 mm, it is considered narrow; and it is obstructed if not seen.

Three months after the procedure, the silicone tube was extracted through the nasal canal by severing the loop between the eyelids. The successful outcomes of surgery considered all patients' symptoms functionally relieved and anatomically working rhinostomy during the follow-up period.

Data Analysis

SPSS software (Statistical Package for the Social Sciences, version 21.0, SPSS Inc., Chicago, IL, USA) was used to perform the statistical analysis. Frequencies and percentages are used to display categorical variables. The Pearson Chi-square test was used to evaluate group comparisons. A p-value of ≤ 0.05 was deemed statistically significant.

RESULTS

This study assessed 50 endoscopic DCR procedures performed on 46 patients. The demographic and clinical characteristics were summarized in Table 1. Of the total procedures, 29 (58%) were in Group A and 21 (42%) in Group B, which included four bilateral cases. All patients presented with preoperative epiphora. In Group A, the etiologies of nasolacrimal duct obstruction were trauma (6 patients), prior acute or chronic dacryocystitis (20 patients), and sequelae of tumor resection surgery (3 cases). In Group B, the causes included trauma (3 patients), congenital nasolacrimal duct obstruction (1 patient), and dacryocystitis (17 patients).

Group A consisted of 29 procedures performed on 29 patients (21 women, 8 men) with a mean age of 43.4 years (range 9–68). These included 22 left-sided and 7 right-sided procedures. Group B comprised 21 procedures on 17 patients (16 women, 1 man) with a mean age of 42.1 years (range 5–70), involving 11 left-sided and 10 right-sided procedures. All patients in both groups underwent primary endoscopic DCR and were followed for one year.

Table 1: Characteristics of the Study Subjects, (n=46).

General Characteristics	Group A	Group B	All Patients
Age:			
Mean	43.4	42.1	42.9
Range	9-68	5-70	5-70
Gender:			
Female	21	16	37
Male	8	1	9
Total	**29**	**17**	**46**
Laterality*:			
Left	22	9	31
Right	7	12	19
Total	**29**	**21**	**50**
Powered instrument			
Done	3	2	5
Additional Procedures:			
Septoplasty	6	2	8
FESS	2	2	4
Partial middle turbinate resection	5	3	8

*Number of operated sides (Four patients were operated bilaterally)

In Group A, concurrent procedures included septoplasty (n=6), conchoplasty (n=2), partial excision of the bulbous middle turbinate (n=3), and FESS for chronic sinusitis with polyposis (n=2). In Group B, concurrent procedures were FESS (n=2), partial turbinate excision (n=3), and septoplasty (n=2). Powered instrumentation was used in three cases in Group A and two in Group B. No perioperative complications occurred. Endoscopic

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evaluation of the patency of rhinostomy was done after one month during the follow-up period for both groups (Table 2); there was no statistically significant difference between the two groups regarding patency (p = 0.4).

Table 2: The Objective Findings in the Study Subjects, (n=50).

Flab	The Objective Finding						*Total*	*p-Value*
	Patent		Narrow		Obstruction			
	N	%	N	%	N	%		
Group A	23	71.9%	8	25%	1	3.1%	**32(100%)**	
Group B	10	55.6%	6	33.3%	2	11.1%	**18(100%)**	**0.4**
Total	**33**	**66%**	**14**	**28%**	**3**	**6%**	**50(100%)**	

Regarding subjective improvement between the two groups, 27 (93.1%) improved in group A and 16 (94.1%) in group B with no statistically significant difference (P-value was 0.3). Table 3. Three cases having epiphora (6.5%). There was no relation between the size of the rhinostomy and the presence of epiphora even in narrow rhinostomy.

Table 3: The Subjective Improvements in both Groups of the Study Subjects

Flap	Epiphora		Total	*p-Value*
	Improved	Not improved		
Group A	27(93.1%)	2(6.9%)	29(100%)	0.3
Group B	16(94.1%)	1(5.9%)	17(100%)	
Total	**43(93.5%)**	**3(6.5%)**	**46(100%)**	

Table 4 lists all of the postoperative complications that were seen in both groups. None of the patients experienced intraoperative problems. Two patients experienced nasal hemorrhage, one had periorbital edema, and one had eyelid ecchymosis during the postoperative period for Group A. Three patients in Group B had periorbital edema, and one patient had bleeding after surgery. In one instance, extensive anterior bone removal using the Kerrison rongeur unintentionally exposed cheek fat during the procedure; nevertheless, this did not cause any postoperative discomfort. The two groups' complication rates did not differ significantly, according to statistical analysis (p = 0.4).

Table 4: Postsurgical Complications

	Group A	Group B	All Patients	*p-Value*
Early post-operative complications				
Bleeding	2	1	3	
Periorbital edema		1	1	
Eyelid ecchymosis	1		1	
Cheek fat exposure		1	1	**0.4**
Late complications				
Synechia	1	3	4	
Granulation tissue	1	3	4	
Obstructed rhinostomy	1	2	3	

Every patient underwent lacrimal intubation, and the tubes were taken out after three months. If the patient had one or more of the following postoperative findings—persistent epiphora, recurrent dacryocystitis, incapacity to irrigate the lacrimal system, or neo-ostium blockage by granulation tissue or synechia as seen on nasal endoscopy—the surgery was deemed ineffective. Table 4 displays the outcomes of the endoscopic evaluation.

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Two patients in group A showed considerable synechia between the middle turbinate and the lateral nasal wall, which resulted in a blocked neo-ostium, and one patient had granulation tissue. Four patients in group B who had their nasal mucosa removed had granulation tissue at the rhinostomy entrance, and three developed synechia, one of which resulted in neo-ostium blockage. The surgical success rates were 93.1% in group A and 94.1% in group B. Statistical analysis revealed no significant difference between the groups, with a p-value of 0.3.

DISCUSSION

Several technical variations of endonasal dacryocystorhinostomy (DCR) have been reported, all providing a safe and effective treatment for nasolacrimal duct (NLD) obstruction. The endoscopic endonasal approach offers distinct advantages over external DCR, such as the avoidance of a visible external scar near the medial canthus and the preservation of the orbicularis muscle's lacrimal pump function, usually resulting in less intraoperative bleeding, shorter hospital stays, and less discomfort following surgery. Additionally, it facilitates the simultaneous endoscopic repair of intranasal diseases such as septal deviation or paranasal sinusitis, speeds up recovery, requires less time for surgery, and can be done bilaterally when needed [22–25].

External DCR success rates range from 75% to 99%, according to a study of the literature. While laser-assisted endoscopic DCR has somewhat lower efficacy, with rates ranging from 77% to 83%, documented success rates for endoscopic DCR carried out without a laser range from 82% to 95% [26, 27]. To facilitate mucosal anastomosis between the lacrimal sac and the nasal lining, Tsirbas et al. proposed a technique that preserves nasal mucosa by creating anterior and posterior flaps within the sac itself [14].

According to Mahendran *et al*., in order to access the lacrimal sac, the surrounding mucosa and bone must be removed, leaving some of the lacrimal bone visible at the conclusion of the procedure. The development of granulation and scar tissue surrounding the surgical incision may be encouraged by this exposed area. Mahendran and associates developed the use of a free mucosal graft to cover the denuded bone in patients having endoscopic endonasal DCR in order to lessen this problem [28].

Kansu and colleagues report no statistical significance between flap preservation technique and flap removal [29]. Our study is compatible with this study; we have found no statistical significance between group A with a preserved mucosal flap and group B with a removed mucosal flap regarding success rate. To improve surgical access to the lacrimal sac and avoid postoperative adhesions between the turbinate and the lateral nasal wall at the site of the rhinostomy, patients with a deviated nasal septum or an enlarged middle turbinate had septoplasty or partial turbinectomy [30].

The effectiveness of surgery depends on removing enough surrounding bone to create a large enough intranasal stoma. This lowers the possibility of adhesions and postoperative stenosis. The most common reason for stomal stenosis following surgery is inadequate bone removal [31].

Anatomical success in DCR surgery does not guarantee functional success. The persistence of epiphora symptoms despite an anatomically accessible postoperative drainage channel is known as functional failure [32]. In our series we found that both objectively patent (66%) and narrow rhinostomy opening (38%) were subjectively functionally successful.

The evaluation of post-operative subjective improvement of epiphora in this series showed rates of 93.1% for group A and 94.1% for group B. The difference between the groups was not statistically significant (p = 0.3). The development of granulation tissue and synechiae was the main consequence of endonasal DCR. Because of the exposed bone after the removal of the mucosal flap, this happened more often in Group B than in Group A. Granulation tissue formation can be inhibited by using intranasal steroids for three months following surgery.

Despite the possibility of postoperative problems suggested by the literature, the rate of complications directly attributable to the endoscopic surgical technique was minimal. Moreover, there were no intraoperative complications except one case with cheek fat exposure due to too much bone removal anteriorly; postoperative complications were all mild and did not require a return to the operative theater.

CONCLUSION

Nasolacrimal duct (NLD) obstruction can be safely and successfully treated with endoscopic procedures. According to our research, there is no discernible difference in the surgical results between endoscopic endonasal DCR carried out with and without mucosal flap preservation. Furthermore, there was no correlation between the functional success of the produced intranasal ostium and its size.

Authors Contributions

Tawfeek Ali Saeed AlShamsi conceived the study, performed the surgical procedures, and drafted the manuscript. Khaled Abdul Hameed Abdul Aziz Mohi Addeen conducted the data analysis and contributed to the critical revision of the manuscript. Both authors reviewed and approved the final version of the manuscript.

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Data Availability

All raw data related to this study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare that there is no conflict of interest.

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