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Original Research Article

Endoscopic endonasal dacryocystorhinostomy with mucosal flap preservation: a prospective clinical study

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ABSTRACT

Background: Chronic dacryocystitis due to nasolacrimal duct obstruction (NLDO) commonly presents with persistent epiphora and may require surgery when conservative treatment fails. This study evaluated the efficacy and safety of endoscopic endonasal dacryocystorhinostomy (EE-DCR) with preservation of the nasal mucosal flap.
Methods: A prospective cohort study was conducted over one year in 20 patients with chronic dacryocystitis secondary to NLDO who did not respond to conservative treatment. All patients underwent EE-DCR with preservation of the nasal mucosal flap to cover the raw bony edges of the rhinostomy site. Patients were assessed postoperatively at 1, 2, and 6 weeks by lacrimal syringing and nasal endoscopy for duct patency and complications.
Results: Mucosal flap preservation was achieved in all 20 patients. At 6 weeks, 18 patients (90%) had complete relief of epiphora with satisfactory healing of the rhinostomy site. Mucosal flap necrosis occurred in 1 patient (5%) and granulation tissue formation in 1 patient (5%), giving an overall complication rate of 10%. Lacrimal syringing showed complete duct patency in 90% of patients (χ^2=11.8, p<0.001). No intraoperative orbital penetration was observed.
Conclusions: EE-DCR with mucosal flap preservation was effective in most patients and was associated with a low complication rate. It appears to be a useful minimally invasive approach for chronic dacryocystitis due to NLDO. However, the small sample size and short follow-up limit the strength of the findings.

Keywords: Dacryocystorhinostomy, Nasolacrimal duct obstruction, Dacryocystitis, Surgical flaps, Endoscopy, Treatment outcome

INTRODUCTION

The lacrimal pathway comprises the lacrimal puncta, canaliculi, lacrimal sac and the nasolacrimal duct (NLD), which drains the tears secreted by lacrimal glands into the inferior meatus of the nose.[1] Diseases involving the lacrimal passage may lead to obstruction to normal flow of tears. Out of various sites of lacrimal pathway, nasolacrimal duct blockade is the most common cause of acquired lacrimal drainage system obstruction.[2] Nasolacrimal duct blockage causes tear stasis in the lacrimal sac, leading to dacryocystitis, which can be acute or chronic. Acute cases are treated with antibiotics, anti-inflammatory drugs and cold compresses. Chronic dacryocystitis, resistant to medical treatment, is managed surgically with dacryocystorhinostomy. Dacryocystorhinostomy (DCR) is a surgical procedure that creates a direct communication between the lacrimal sac and the nasal cavity to restore the natural drainage of tears in patients with nasolacrimal duct obstruction

(NLDO).[3] The traditional external DCR, despite its high success rates, involves facial incisions that can result in scarring, longer recovery, and patient dissatisfaction. In an effort to overcome these limitations, endoscopic endonasal dacryocystorhinostomy (EE-DCR) was introduced in the late 1980s as a less invasive alternative. EE-DCR utilizes endoscopic techniques to create the new drainage pathway through the nasal cavity, avoiding external incisions. This approach not only reduces the risk of scarring but also allows for direct visualization of the surgical site, improving the precision of the surgery.[4] Despite its advantages, one of the challenges faced in endoscopic DCR is ensuring the long-term patency of the newly created passage between the lacrimal sac and the nasal cavity. Postoperative scarring and granulation tissue formation can lead to restenosis of the nasolacrimal duct, compromising the success of the surgery.[5] To reduce the incidence of restenosis, various techniques have been developed, including the use of mucosal flaps in endoscopic DCR. This technique involves creating and positioning nasal mucosal flaps to cover the raw edges of the rhinostomy site. This method is believed to promote faster healing, reduce granulation tissue formation, and maintain the patency of the nasolacrimal duct. The mucosal flaps serve as a protective layer, preventing the raw edges from sticking together and ensuring a stable and functional rhinostomy over the long term.[6] The present study was conducted to evaluate the results of endoscopic dacryocystorhinostomy with the technique of preserving mucosal flaps where bare bone superior and inferior to the rhinostomy was covered by flaps fashioned from the mucosa covering the frontal process of maxilla. Despite growing evidence supporting mucosal flap preservation in EE-DCR, few studies have evaluated its outcomes in a diverse age range with a focus on intraoperative flap success and postoperative complications.

Objectives

The objectives were to evaluate the efficacy and safety of endoscopic endonasal dacryocystorhinostomy (EE-DCR) with mucosal flap preservation in restoring tear drainage and improving outcomes in patients with chronic dacryocystitis due to nasolacrimal duct obstruction.

METHODS

Study design

This prospective cohort study, conducted at the Department of Otorhinolaryngology, Pt. B.D. Sharma PGIMS, Rohtak, from January 2023 to January 2024, evaluated the efficacy of endoscopic endonasal dacryocystorhinostomy (EE-DCR) with mucosal flap preservation for chronic dacryocystitis due to nasolacrimal duct obstruction (NLDO) refractory to conservative treatments. Approved by the institutional ethical committee, the study enrolled 20 patients of both sexes, ensuring a clear indication for surgical intervention. Over one-year, comprehensive follow-up assessed symptom relief, lacrimal patency, and rhinostomy site healing, demonstrating EE-DCR's effectiveness in restoring tear drainage and minimizing postoperative complications like restenosis.

Inclusion criteria

Inclusion criteria included Patients aged between 5 and 70 years and patients diagnosed with chronic dacryocystitis secondary to nasolacrimal duct obstruction that was resistant to conservative management.

Exclusion criteria

Exclusion criteria included patients with a lacrimal abscess who required control of active inflammation prior to surgery. Individuals suffering from acute nasal or sinus infections. Patients who had a history of dacryocystorhinostomy. Those with a previous history of maxillofacial trauma. Patients presenting with nasal tumours and individuals with uncontrolled systemic diseases, including diabetes mellitus and hypertension.

Sample size

Sample size = $4pq/l^2$

P = prevalence.

Taking success rate of 93.3% as the prevalence.[7]

q=1-p = 6.7%

l=allowable error in study=10% of prevalence =9.33%

Sample size = $4\times93.3\times6.7/9.33\times9.33=28.72\sim29$.

Due to the time bound nature of the study, all consecutive patients meeting the eligibility criteria during the study period were enrolled, resulting in a total of 20 patients.

Sampling method

This study employed consecutive sampling to recruit 20 patients with chronic dacryocystitis due to nasolacrimal duct obstruction at the Department of Otorhinolaryngology, Pt. B.D. Sharma PGIMS, Rohtak, ensuring an unbiased sample. Eligible patients, identified during routine outpatient visits, were enrolled after meeting inclusion criteria until the target sample size was reached. Informed consent was obtained from all participants, ensuring voluntary participation. The study adhered to ethical guidelines, with approval from the institutional ethics committee. Patient confidentiality and data privacy were rigorously maintained throughout the research, aligning with ethical standards to protect participant rights and ensure study integrity.

Surgical procedure

Patients were positioned supine with their heads in a neutral position and the operating table tilted to a 30-degree reverse Trendelenburg position. If nasal septum

obstruction was present, septoplasty was performed. The mucosal incisions were made with a #15 scalpel blade. Incisions were made as follows: a superior horizontal incision 8 mm above the axilla of the middle turbinate, extending 3 mm posteriorly to the axilla and 10 mm anteriorly onto the frontal process of the maxilla; a vertical incision from the first incision to the insertion of the inferior turbinate; and an inferior horizontal incision extending from the insertion of the uncinate process to the vertical incision. After giving incisions, the mucoperiosteal flap was elevated and pushed posteriorly towards the middle turbinate. The frontal process of maxilla thus exposed was removed using a Kerrison's rongeur and a 2.5mm rough diamond burr until the entire lacrimal sac was exposed. A #11 scalpel blade was used to give vertical incision through the sac wall. Releasing incisions were made anteriorly and posteriorly on the lacrimal flaps to ensure proper marsupialization of the sac. These tools were selected for their precision in removing the frontal process of the maxilla, ensuring complete lacrimal sac exposure. The preserved mucosal flap was incised in the middle; the upper and lower limbs thus formed were used to cover the bare bone superior and inferior to the rhinostomy. Gel foam pieces were used to stabilise the flaps. Light anterior nasal packing was performed for 24 hours. Follow-up visits occurred at 1, 2, and 6 weeks, where subjective symptoms like epiphora and eye discharge were assessed, along with objective examination of the rhinostomy site at 1,2 and 6 weeks. The lacrimal patency was assessed using a 23G lacrimal cannula. The 6-week follow-up limits long-term outcome assessment, and future studies with 1–2-year follow-ups are planned to evaluate durability.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 20.0. Descriptive statistics summarized demographics and outcomes. The Shapiro-Wilk test assessed normality of continuous variables (e.g., age). Chi-square goodness-of-fit tests evaluated epiphora relief and rhinostomy site outcomes at 6 weeks, assuming equal expected frequencies (6.67 per category). Chi-square tests for independence assessed associations between categorical variables (e.g., age, complications). Degrees of freedom were calculated appropriately. A p-value < 0.05 indicated significance. For small expected frequencies, results were interpreted cautiously, with Fisher's exact test considered as an alternative.

RESULTS

Among the 20 patients, 65.0% were female (n=13), while males constituted 35.0% (n=7). The male: female ratio was found to be 1:1.86. The mean age of patients was 34.6±20.0 years. Statistical analysis showed no significant difference across age groups. These results underscore that nasolacrimal duct obstruction may manifest across all age demographics, frequently requiring surgical intervention for optimal resolution. Only 5% (n=1) needed septoplasty for a right-sided deviation. Mucosal flap preservation and covering of the bare bone superior and inferior to the rhinostomy site was achieved in all cases of endoscopic endonasal dacryocystorhinostomy, with 100.0% (n=20) of the patients undergoing the procedure. None of the 20 patients undergoing endoscopic endonasal dacryocystorhinostomy in our study showed signs of orbital penetration, highlighting the safety and precision of the technique.

Ninety percent (n=18) of patients undergoing endoscopic endonasal DCR experienced complete symptom relief, indicating the procedure's high effectiveness. 5% (n=1) had partial relief, while another 5% (n=1) reported no relief. Mucosal flap preservation was successful in the majority but not all cases, with two patients (10%) showing suboptimal symptom relief. The chi-square (χ^2) value was 28.9, with a p-value of <0.001, showing a statistically significant difference in outcomes. This goodness-of-fit test assumed equal expected frequencies (6.67 per category), reflecting the predominance of symptom relief compared to a hypothetical uniform distribution, highlighting EE-DCR's efficacy using our technique in most cases. The distribution of study subjects according to post-operative relief of subjective symptom that is epiphora is presented underneath in Table 1.

Table 1: Distribution of study subjects according to subjective relied from epiphora.

Symptoms (Epiphora)	Number of patients			% of Total	Chi-square (χ^2) & p value
	1st week post-op	2nd week post-op	6th week post-op		
Not relieved	1	1	1	5.0 %	χ^2=28.9, p=<0.001
Partially relieved	1	1	1	5.0 %	
Relieved	18	18	18	90.0 %	
Total	**20**			100.0%	

For the 6th-week post-operative outcomes of endoscopic endonasal dacryocystorhinostomy (EE-DCR) in 20 patients, the observed frequencies were 18 (normal, 90%), 1 (mucosal flap necrosis, 5%), and 1 (granulation tissue, 5%). A chi-square goodness-of-fit test, assuming equal expected frequencies (6.67 per category), yielded a chi-square statistic of 28.9 with 2 degrees of freedom and a p-value < 0.001, indicating a significant deviation from

a uniform distribution. Mucosal flap preservation was successful in the majority (90%) but not all cases, with two patients (10%) experiencing complications. These results have been depicted in Table 2.

Table 2: Distribution of study subjects according to post-operative condition of rhinostomy site.

Post-operative examination	Number of patients			% of Total	Chi-square (χ^2) & p value
	1st week post-op	2nd week post-op	6th week post-op		
Normal	20	20	18	90.0%	χ^2=28.9, p=<0.001
Mucosal flap necrosis	0	0	1	5.0 %	
Formation of granulation tissue at rhinostomy site	0	0	1	5.0%	
Total	20			100.0%	

At 6 weeks post-endoscopic endonasal dacryocystorhinostomy (EE-DCR) in 20 patients, lacrimal syringing showed 18 patients (90%) with patent lacrimal drainage and 2 patients (10%) with partial patency and fluid regurgitation via opposite punctum of eye. Mucosal flap preservation was effective in most cases but not all, with 10% experiencing suboptimal outcomes. A chi-square goodness-of-fit test, assuming equal expected frequencies (10 per category), yielded a chi-square statistic of 11.8 (df=1, p< 0.001), indicating significantly higher patency rates than a hypothetical uniform distribution, underscoring EE-DCR's efficacy using our technique of mucosal flap preservation. These results of post-operative lacrimal syringing are shown in Table 3.

Table 3: Distribution of study subjects according to post-operative lacrimal syringing of the operated eye.

Findings of post-op lacrimal syringing of operated side (6 weeks)	Number of patients	% of Total	Chi-square (χ^2) & p value
Patent	18	90 %	χ^2=11.8, p=<0.001
Partially patent with regurgitation of fluid in opposite puncta	2	10 %	
Total	**20**	**100.0%**	

Among comorbidities, 5% (n=1) had prior eye exenteration due to glaucoma, likely a modified procedure preserving the lacrimal apparatus, allowing EE-DCR to be performed.

DISCUSSION

The most commonly affected mean age range in the present study was found to be 34.6±20.0 years. Statistical analysis (χ^2=4.50, p=0.609) showed no significant difference across age groups, indicating that dacryocystitis is relevant across all ages often needing medical and surgical management. Hamdy et al. studied 65 patients and found no significant age-related impact on outcomes, similar to our findings.[8] Shahid et al. analyzed 100 patients and reported the majority (35%) in the 31–50 years group, with a mean age of 38.4 years, also finding no significant age effect on surgical success.[9] These studies collectively demonstrate that age does not limit the effectiveness of DCR in treating nasolacrimal duct obstruction.

In our study, 65% of patients were female, while 35% were male, with no significant gender association (χ^2=1.80, p=0.180). This is consistent with the higher prevalence of nasolacrimal duct obstruction in females, possibly due to smaller duct diameters.[10] Similar gender distributions were reported in studies by Hamdy et al. (60% female), Shahid et al. (68% female, and Zloto et al (70% female), all aligning with our findings and supporting the trend of female predominance in nasolacrimal duct obstruction.[8,9,11]

In our study, 80% of patients had unilateral (U/L) nasolacrimal duct obstruction, 15% had bilateral (B/L) obstruction, and 5% had a prior history of exenteration due to glaucoma which was likely a modified procedure thereby preserving the lacrimal apparatus. The chi-square test (χ^2=19.9, p<0.001) confirmed that unilateral obstruction was significantly more common. This is consistent with studies by Flarence et al, who reported 78% U/L and 17% B/L cases, and Zloto et al, with 75% U/L and 20% B/L cases.[11,14] Both studies found that DCR was effective for both U/L and B/L obstructions. These findings reinforce that unilateral obstruction is more prevalent, though DCR is effective for both types. In the present study, 55% of patients underwent endoscopic

DCR on the right side, while 45% had it on the left. The chi-square test (χ^2=0.20, p=0.655) showed no significant side difference, indicating that NLDO affects both sides equally and that surgical outcomes are unaffected by the side treated. A study by the American Society of Ophthalmic Plastic and Reconstructive Surgery (ASOPRS) offers a similar perspective on the management of NLDO. Their report emphasizes that DCR procedures are performed with a balanced distribution between both sides, and they found no clinically significant preference for one side over the other.[12] These findings reinforce that nasolacrimal duct obstruction occurs equally on both sides and that DCR is effective regardless of the side.

In terms of co-morbidities, 85% of our patients had no comorbidities, while 5% had Type 2 Diabetes mellitus, 5% had a past eye exenteration due to glaucoma, and 5% had a congenital laryngeal web. These findings align with previous studies, such as those by Li et al (7% diabetes) and Rikhtehgar et al (8% glaucoma), emphasizing the need to manage comorbidities during recovery.[15,16]

Regarding anaesthesia, in our study, 60% of patients underwent DCR with local anaesthesia, and 40% with general anaesthesia. Statistical analysis (χ^2=0.80, p=0.371) showed no significant difference in outcomes, indicating both methods are viable options. Shahid et al. (62% local, 38% general) and Demir et al (58% local, 42% general) found similar results, with a preference for local anaesthesia due to its faster recovery and fewer complications, while achieving comparable surgical outcomes.[9,13] These studies support the flexibility of anaesthesia choice in DCR, allowing for tailored patient care based on clinical needs or preferences. In our study, 95% of patients undergoing endoscopic endonasal dacryocystorhinostomy (DCR) did not require septoplasty, with only 5% needing it due to a right-sided deviated nasal septum. This suggests septoplasty is uncommon in DCR. Demir et al. reported 10%, and Tsirbas and Wormald found that 8% required septoplasty, further supporting that septal correction is rarely needed.[13,17] The low incidence in our study reflects the adaptability of the minimally invasive approach. In the present study mucosal flap preservation was achieved in 100% of cases. This technique reflects a growing emphasis on preserving mucosa to optimize surgical outcomes. This indicates that mucosal flap preservation is feasible and reproducible, supporting its use as a standard approach during this surgery. Preserving the mucosal flap is considered beneficial as it promotes faster healing, maintains nasal physiology and reduces the risk of post-operative complications such as restenosis. In our study, no intraoperative orbital penetration occurred in any of the 20 patients (100%), reflecting the safety and precision of the surgical techniques used. This aligns with Shahid et al, who also reported no orbital injuries in 100 DCR cases.[9] Ghiam and Kacker documented minimal complications, while Demir et al. noted a rare case of orbital fat exposure, highlighting that such complication, although uncommon, may occur in complex anatomical cases or with less experienced surgeons.[18,13] These findings highlight the importance of surgical expertise and meticulous technique, confirming that endonasal DCR is a safe, effective procedure when performed with care and precision.

In the present study, 90% of patients experienced complete relief from epiphora after endoscopic dacryocystorhinostomy (DCR), with 5% reporting partial relief and 5% showing no improvement. These results demonstrate the procedure's high success in resolving tear overflow in 90% of the enrolled patients, though not all. Zloto et al found 80% relief, emphasizing the importance of mucosal flap preservation for optimal outcomes, aligning with our findings that precision and proper care are key to success.[10]

90% (18 patients) of patients in our study exhibited normal healing at the rhinostomy site postoperatively, indicating effective surgical outcomes in majority of patients. However, 5% developed mucosal flap necrosis, requiring flap removal, while another 5% experienced granulation tissue formation, which required additional intervention. These results are consistent with studies by Wang et al., who found granulation tissue in 7% cases following endoscopic DCR using lobulated flap preservation technique, and Hamdy et al., who observed complications in 8% of cases.[18,7] Both studies emphasized the importance of timely management, such as debridement or medication, to address these issues without compromising long-term success. These findings highlight that while complications are infrequent, prompt treatment is crucial for maintaining optimal recovery.

Complete patency of the lacrimal drainage system was achieved in 90% of patients, as confirmed by postoperative lacrimal syringing, indicating highly successful outcomes. However, 10% showed partial patency, with fluid regurgitation from the opposite punctum, requiring further monitoring or potential revision surgery. These findings align with those of Rezaeian et al, who reported a 90% patency rate, with 10% of patients experiencing partial obstruction, stressing the importance of follow-up care for managing residual blockages.[20] Hamdy et al also found a 92% patency rate, with 8% showing partial obstruction.[8] Both studies, like ours, emphasize the significance of surgical precision and proactive postoperative care to ensure optimal long-term results. This reinforces the reliability of DCR with mucosal flap preservation and highlights the need for vigilant monitoring and management of partial obstructions to achieve the best possible outcomes.

The results of this study demonstrate that preserving mucosal flaps during EE-DCR offers significant benefits in terms of reducing complications, such as granulation tissue formation, and improving the overall success rate of the procedure. In terms of clinical implications, the results of this study suggest that EE-DCR with mucosal

flap preservation may become the preferred technique for treating patients with NLDO. The minimally invasive nature of EE-DCR, combined with the benefits of flap preservation, offers a highly effective solution for patients who require surgical intervention but wish to avoid the drawbacks of external DCR. Furthermore, the technique's reduced complication rate and quicker recovery time make it an attractive option for patients with nasolacrimal duct obstruction especially those with comorbid conditions like diabetes mellitus who may be at higher risk for complications from traditional surgical methods.

Limitations

This study is limited by its small sample size of 20 patients, which may restrict the generalizability of findings to broader populations with nasolacrimal duct obstruction. Additionally, the 6-week follow-up period is insufficient to assess long-term outcomes, such as sustained lacrimal patency or recurrence rates. Future research with larger, more diverse cohorts and extended follow-up durations (1–2 years) is needed to validate the efficacy and durability of endoscopic endonasal dacryocystorhinostomy with mucosal flap preservation.

CONCLUSION

This prospective study evaluated endoscopic endonasal dacryocystorhinostomy (EE-DCR) with mucosal flap preservation in 20 patients with chronic dacryocystitis due to nasolacrimal duct obstruction. Lacrimal syringing confirmed complete duct patency in 90% of cases, with 90% achieving complete epiphora relief and normal rhinostomy site healing at 6 weeks. Mucosal flap preservation, supported by lacrimal stenting, was effective in most cases (90%), though 10% experienced complications (mucosal flap necrosis or granulation tissue). These findings support EE-DCR as a safe, minimally invasive alternative to external DCR. However, the small sample size and 6-week follow-up limit generalizability and long-term outcome assessment. Larger, multicenter studies with extended follow-up (1–2 years) are needed to validate the durability and broader applicability of this technique.

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