

Original Research Article

A comparative study of complete removal of medial wall of lacrimal sac against mucosal flap technique in endoscopic endonasal dacryocystorhinostomy

Ganesh D. Borewad*, Samir V. Joshi

Department of ENT, BJ Medical College and Sassoon Hospital, Pune, Maharashtra, India

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*Correspondence:

Dr. Ganesh D. Borewad,

E-mail: ganeshborewad16@gmail.com

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ABSTRACT

Background: Dacryocystorhinostomy (DCR) is the standard surgical treatment for nasolacrimal duct obstruction (NLDO), creating a fistulous tract between the lacrimal sac and the nasal cavity to relieve epiphora. While considerable literature exists comparing external DCR with endoscopic endonasal DCR, there are few comparative studies evaluating the outcomes of endoscopic endonasal DCR with mucosal flap preservation versus complete removal of the medial wall of the lacrimal sac.

Methods: This was a single-center, prospective, comparative study conducted at the Department of ENT, BJMC and Sassoon Hospital, Pune, Maharashtra, India, from June 2019 to December 2020. Fifty patients with nasolacrimal duct obstruction were allocated into two groups of 25 each: Group A (complete removal of medial wall of lacrimal sac) and Group B (mucosal flap technique). Lacrimal system patency was assessed at three and six months postoperatively using the sac syringing technique.

Results: Surgical success at six months was 100% in Group B versus 92% in Group A, though this difference was not statistically significant ($p=0.490$). There was no significant difference in postoperative pain scores between the groups ($p=0.810$). Ostium size shrinkage was 21.3% in Group A and 15.8% in Group B ($p=0.157$). Early and late postoperative complications, including granulation tissue formation and synechiae, were relatively higher in Group A.

Conclusions: Mucosal flap technique and complete excision of the medial wall of the lacrimal sac in endoscopic endonasal DCR demonstrate comparable outcomes. Although statistically insignificant, the mucosal flap technique showed lower complication rates and less ostium shrinkage.

Keywords: Dacryocystorhinostomy, Endoscopic, Epiphora, Nasolacrimal duct obstruction, Mucosal flap

INTRODUCTION

Dacryocystorhinostomy (DCR) is the standard treatment for nasolacrimal duct obstruction.¹ DCR is a commonly performed operation in which a fistulous tract is created between the lacrimal sac and the nasal cavity to alleviate epiphora caused by nasolacrimal duct obstruction.²⁻⁴ The external approach of DCR is the traditional technique of choice by ophthalmologists, in which an incision is made

on the skin and the bone is exposed, followed by an external osteotomy, opening the nasal mucosa, exposing the lacrimal sac and creating the lacrimal sac flaps from outside to the inside. Historically, the majority of surgery for nasolacrimal duct obstruction has been performed through external techniques with excellent outcomes.^{5,6} The endoscopy-assisted endonasal approach follows the inverse pathway. A nasal mucosal flap is firstly created, followed by endoscopic endonasal bone osteotomy to

expose the lacrimal sac and its marsupialization into the nasal cavity. The endoscopic endonasal exposure of the complete lacrimal sac is simply fantastic. Success rates of this procedure by both approaches, the endoscopic and the external one, are higher than 90% in experienced hands.

In 1893, Caldwell, an otorhinolaryngologist, described the endonasal approach to the lacrimal sac and the external approach was described in 1904 by Totti.^{7,8} The external approach was the favoured procedure over the endonasal approach throughout the 20th century. The endonasal approach was abandoned due to inadequate visualization. In 1989, McDonough and Meiring described the first modern endoscopic endonasal DCR procedure. Since then, instruments, visualization, and surgical techniques have evolved to improve endoscopic endonasal DCR (EDCR), which has emerged as a standard method over the past decade.^{9,12} Moreover, the success rates of external DCRs and endoscopic DCRs are now equivalent, according to the findings of several studies, with better cosmetic results reported for endoscopic DCR.

The outcome of the external dacryocystorhinostomy in seasoned hands is around 90-95%, both anatomical and in relieving the symptoms of epiphora, which is very satisfactory.^{5,13} The first series of endoscopic endonasal procedures were published in the late 1980s and early 1990s.¹⁴⁻¹⁶ Nonetheless, outcomes comparable to the external technique were only reached when we started removing the bone and achieving complete exposure of the lacrimal sac.^{4,17}

The initially described endoscopic approach led to the opening of the lacrimal sac on the lateral nasal wall, just anterior to the middle concha. As soon as it was shown that the uppermost extension of the lacrimal sac extends about 8 mm above the middle turbinate insertion on the lateral nasal wall, and not only just anterior to the middle turbinate, it became possible to make the mucosal flaps and achieve complete marsupialization of the lacrimal sac. Thus, the results of such procedures became comparable to those from the external approach.¹⁸

The nasal mucosa that overlies the lacrimal sac is sacrificed in the conventional endoscopic endonasal DCR. One of the modifications of the endoscopic technique performed by some surgeons is the elevation of a mucosal flap before creating the osteotomy, and placing it over the osteotomy site at the end of the procedure to avoid areas of bare bone.¹⁹

The commonly held belief behind this technique is that the preservation of nasal mucosal flaps and repositioning them on bare bone can help in reducing the rate of granulation and synechiae formation and thereby decreasing failure rates. Various techniques of mucosal flap creation have been described, including U-shaped, L-shaped, free nasal, open book and the preservation of the

entire lacrimal mucosa.^{19,20} Literature reports on comparing the external DCR and the endoscopic endonasal DCR procedures abound.

However, there are few comparative studies of the surgical results of endoscopic endonasal DCR with mucosal flaps and complete removal of the medial wall of the lacrimal sac in endoscopic DCR. Hence, this study was conducted among patients who underwent endoscopic endonasal dacryocystorhinostomy in a tertiary care hospital, Pune, to compare patency (success rate) of the lacrimal system in complete removal of the medial wall of the lacrimal sac with the mucosal flap technique using the lacrimal sac syringing technique, and also to compare pain intensity and the size of the ostium created on the lacrimal sac.

METHODS

Study design and setting

This was a single-centre, prospective, hospital-based comparative study conducted among patients undergoing endoscopic endonasal dacryocystorhinostomy in the Department of Otorhinolaryngology (ENT) at B.J. Government Medical College and Sassoon General Hospital, Pune, Maharashtra, India. The study was conducted from June 2019 to December 2020. The study was approved by the institutional ethics committee of BJGMC and SGH, Pune. All participants provided written informed consent prior to enrolment.

Sample size and grouping

Based on the surgical success rates of 100% and 88.3% for the mucosal flap technique and complete removal of the medial wall of the lacrimal sac, respectively, as reported by Kansu L et al²¹ the sample size was estimated to be 23 patients per arm at a 95% confidence level using nMaster V2.0 (Two Proportion-estimating the difference between two proportions based on risk difference). A total of 50 patients were enrolled, with 25 patients in each arm.

Group A (n=25)

Endoscopic endonasal dacryocystorhinostomy by complete removal of medial wall of lacrimal sac.

Group B (n=25)

Endoscopic endonasal dacryocystorhinostomy by mucosal flap technique.

Inclusion criteria

Patients aged 14 to 65 years with chronic dacryocystitis, mucocoele of the lacrimal sac, or acute-on-chronic dacryocystitis were included.

Exclusion criteria

Patients with epiphora due to entropion or ectropion, presacal obstruction, lacrimal sac tumour, or nasal polyp were excluded. Patients who did not provide written informed consent or who did not complete follow-up were also excluded.

Preoperative protocol

After obtaining permission from the institutional ethics committee and written informed consent from the patients, a predefined proforma was used to collect sociodemographic characteristics and clinical profile. Preoperative investigations included routine blood investigations, ECG, chest X-ray, nasal endoscopic examination, and CT of paranasal sinuses when indicated. All patients received a one-week antibiotic course and nasal decongestant one day prior to surgery.

Surgical procedure

The procedure was performed under general anaesthesia. Standard protocol was followed for all patients. In Group A, complete removal of the medial wall of the lacrimal sac was performed. In Group B, the mucosal flap technique was used with flap repositioning over the bony window. Dimension of opening created on lacrimal sac was measured using Blakesley forceps and Surgical scale.

Postoperative care and follow-up

Postoperative care included an oral antibiotic course and antibiotic eye drops for seven days, nasal pack removal after 24 hours, saline nasal douching three times a day for three weeks, and nasal decongestant three times a day for five days. Patients were followed up at three months and six months postoperatively.

Assessment parameters

The following parameters were assessed: patient age, sex, weight, duration of symptoms (months), comorbidities, history of presenting illness, and family history.

Postoperative pain score

Assessed on the evening after surgery using the Numeric rating scale (NRS-11), a segmented numeric version of the Visual analog scale in which a respondent selects a whole number from 0 to 10 reflecting the intensity of pain (0=no pain; 1-3=mild; 4-6=moderate; 7-10=severe).

Patency of the lacrimal system

Assessed at three and six months postoperatively using the lacrimal sac syringing technique. Syringing was performed by flushing through the inferior canaliculus: a positive flush to the oropharynx without reflux indicated a normal nasolacrimal duct; reflux through the superior

canaliculus indicated partial obstruction; failure to reach the oropharynx with secretion through the superior canaliculus indicated complete duct obstruction; failure to reach the oropharynx without secretions indicated common canalicular obstruction; and reflux through the inferior canaliculus indicated inferior canalicular obstruction.

Dimensions of the ostium created on the lacrimal sac

Horizontal and vertical diameters (mm) were measured at the time of surgery and at six months postoperatively, and the surface area (mm²) was calculated.

Operational definition

Surgical success was defined as absence of epiphora and purulent discharge together with a patent lacrimal system at six months postoperatively.

Statistical analysis

Data were analysed using SPSS V21.0 for IBM for Windows. Continuous variables (age, pain score) were presented as mean (SD) or median (IQR) based on the distribution. Categorical variables (gender, clinical presentation) were presented as frequency and percentages. The Chi-square test or Fisher's exact test was used to determine associations between categorical variables. The independent samples t-test was used to compare pain scores and ostium size between the groups. A p value of <0.05 was considered statistically significant.

RESULTS

The mean age of the study participants was 39.0 (±13.1) years (range: 14-65 years). The mean age in group A was 37.1 (±12.9) years (median 38.0 years; range 16-65 years) and in group B was 40.9 (±13.3) years (median 39.0 years; range 14-54 years).

Age distribution was comparable between the groups ($p=0.542$), with the majority in the 31–45-year age group. The majority of participants were female ($n=37$; 74.0%); the male-to-female ratio was 1:2.8, and this was comparable between the groups ($p=0.333$). The left side was more commonly affected in both groups, and laterality was comparable between groups ($p=0.824$).

Epiphora was the most common presenting complaint (88.0% in group A and 92.0% in group B). Dacryocystitis and purulent lacrimal discharge were reported in approximately 40% of participants in each group.

The median duration of symptoms was 3 months (IQR 1-6) in group A and 3 months (IQR 1-4.5) in group B, with no significant difference between groups ($p=0.221$). Comorbidity status was also comparable between the groups ($p=0.758$) (Table 1 and 2). There was no

statistically significant difference in perceived postoperative pain score (NRS) between the two groups (group A mean 2.6 ± 0.6 vs. group B mean 2.5 ± 0.5 ; $p=0.810$). Surgical success at six months was 100% in group B and 92% in group A (23/25 vs. 25/25), though this difference was not statistically significant ($p=0.490$) (Table 3). The mean surface area of the ostium in group

A was 99.3 mm^2 at surgery and 78.2 mm^2 at six months postoperatively, representing a shrinkage of the 21.3%. In group B, the mean surface area was 96.4 mm^2 at surgery and 81.1 mm^2 at six months, a shrinkage of 15.8%. The difference in ostium shrinkage between the groups was not statistically significant ($p=0.157$) (Table 4).

Table 1: Age, gender, laterality, symptom duration and comorbidity distribution of the study population (n=50).

Variables	Group A (n=25) N (%)	Group B (n=25) N (%)	P value
Age group (years)			
≤30	7 (28.0)	4 (16.0)	0.542
31-45	10 (40.0)	14 (56.0)	
46-60	7 (28.0)	5 (20.0)	
>60	1 (4.0)	2 (8.0)	
Gender			
Male	8 (32.0)	5 (20.0)	0.333
Female	17 (68.0)	20 (80.0)	
Laterality (affected side)			
Right	10 (40.0)	9 (36.0)	0.824
Left	14 (56.0)	14 (56.0)	
Bilateral	1 (4.0)	2 (8.0)	
Duration of symptoms (years)			
<1	20 (80.0)	23 (92.0)	0.221
≥1	5 (20.0)	3 (8.0)	
Co-morbidities			
Present	7 (28.0)	8 (32.0)	0.758
Absent	18 (72.0)	17 (68.0)	

Table 2: Distribution of study participants by presenting symptoms between the groups (n=50).

Symptoms	Group A (n=25) N (%)	Group B (n=25) N (%)
Epiphora	22 (88.0)	23 (92.0)
Dacryocystitis (pain and redness over medial canthus)	9 (36.0)	11 (44.0)
Purulent lacrimal discharge	8 (32.0)	10 (40.0)

Table 3: Comparison of postoperative pain score and surgical success between the groups (n=50).

Group	Pain score (NRS) mean (SD)	P value
Group A (n=25)	2.6 (0.6)	0.810
Group B (n=25)	2.5 (0.5)	
Surgical success	Group A (n=25) N (%)	Group B (n=25) N (%)
Success	23 (92.0)	25 (100.0)
Failure	2 (8.0)	0 (0.0)
P value	0.490	

Table 4: Mean dimensions of the lacrimal sac ostium at surgery and at six months postoperatively (n=50).

Time	Group A: horizontal (mm) mean (SD)	Group A: vertical (mm) mean (SD)	Group A: area (mm^2) mean (SD)	Group B: horizontal (mm) mean (SD)	Group B: vertical (mm) mean (SD)	Group B: area (mm^2) mean (SD)
At surgery	8.2 (0.7)	12.1 (0.8)	99.3 (7.6)	7.9 (0.8)	12.1 (0.9)	96.4 (11.6)
6 months postop	7.3 (0.8)	10.6 (0.6)	78.2 (9.9)	7.5 (1.1)	10.9 (0.9)	81.1 (15.0)

Table 5: Early and late postoperative complications among study participants (n=50).

Complications	Group A (n=25) N (%)	Group B (n=25) N (%)
Early postoperative complications		
Haemorrhage	4	2
Periorbital oedema	4	1
Eyelid ecchymosis	3	1
Late postoperative complications		
Synechiae	3	1
Granulation tissue formation	5	0
Reobstruction	1	0

Both early and late postoperative complications were relatively more frequent in Group A. Notable late complications in group A included granulation tissue formation (n=5) and synechiae (n=3), compared to none and one, respectively, in group B. Septoplasty was required in seven patients and concha resection was performed in three patients (Table 5).

DISCUSSION

A study conducted by Kamal S et al and Cokkeser Y et al reported mean ages of 34 years and 38.5 years respectively, which are similar to our study findings.^{22,23} Similarly, studies by Jyothi AC et al and Pradeep KV et al reported that the condition was common among the middle age group.^{24,25} This age distribution could be attributed to a tendency of atony of the sac with age, leading to stagnation of tears and eventually chronic irritation, inflammation, and decreased immune protection against microbial invasion. Similar results were reported by various other studies across the country.²⁶⁻³⁰

The female sex predilection was reported by Deviprasad D et al, Kansu L et al, Pradeep KV et al, Ramakrishnan VR et al, and Zloto O et al.^{31,21,25,33} The female preponderance may be due to the relatively narrower and flatter bony nasolacrimal canal in females compared to males, predisposing them to canalicular obstruction. Similar results have been noted in the majority of published studies.³⁴⁻³⁷

Tsirbas A et al compared endoscopic DCRs to external procedures and reported statistically equivalent success rates for the two techniques (93.5% versus 95.8%), emphasising the importance of complete bone removal and mucosal flap preservation.³⁷ Ramakrishnan VR et al performed 27 endoscopic DCRs without mucosal flap preservation and noticed a success rate of 100% for anatomic patency and 93% for complete resolution of epiphora, concluding that mucosal flap preservation may not be required for a successful outcome.³² Similar individual studies were conducted by Jyothi AC et al, Marcet MM et al, and Green R et al, with all establishing corresponding success rates.^{24,38,39} Those who favour flap preservation argue that the lacrimal sac mucosa allows healing by primary intention, and that poor or minimal

preservation of mucosa may lead to increased granulation tissue formation, fibrosis, and reobstruction. Our study showed that the surgical success rate at six months was higher for patients who underwent the mucosal flap technique compared to those who underwent complete removal of the medial wall of the lacrimal sac (100.0% vs. 92.0%), though this was not statistically significant ($p=0.490$).

Notably, there are very few studies comparing both these procedures and no strong consensus exists for the preferred method. Results similar to our findings were reported by Deviprasad D et al, Kansu L et al, Zloto O et al, and Khalifa MA et al.^{31,21,33,40} In contrast, Ji QS et al reported significantly higher success rates in the mucosal flap group compared to the non-flap group.⁴¹ Larger multicenter studies are needed to add greater objectivity to these findings.

Both early and late complications were more frequent among patients who underwent complete removal of the medial wall of the lacrimal sac.

A study by Mahendran S et al explained that the exposed lacrimal bone at the end of surgery can lead to granulation and scar tissue formation around the lacrimal window.⁴² Zilelioglu G et al reported surgical failure in 17% of subjects due to granulation tissue obstructing the osteotomy site.⁴³ In the study by Kansu L et al, revision surgery was not required in the mucosal flap group, achieving a 100% surgical success rate.²¹ The greater ostium shrinkage observed in group A (21.3% vs. 15.8%) is consistent with the hypothesis that granulation tissue formation and secondary intention healing in the absence of mucosal flap coverage leads to contracture of the lacrimal ostium.

Strengths and limitations

One of the strengths of this study is that it was conducted among a representative sample of patients at a tertiary care hospital, enhancing generalisability to similar settings. However, randomisation was not performed and hence there is a possibility of selection bias. The sample size was relatively small, and a larger randomised controlled trial would provide more definitive conclusions.

CONCLUSION

Our study indicates that the mucosal flap technique and complete excision of the medial wall of the lacrimal sac in endoscopic endonasal DCR demonstrate comparable outcomes and complication profiles. Although statistically insignificant, the mucosal flap technique showed marginally superior clinical results, with lower complication rates, lesser ostium shrinkage, and a trend towards higher surgical success. Mucosal flap surgery requires more surgical skill, as flap repositioning and bone window size are critical determinants of outcome. We recommend that surgeons choose their technique based on their experience and expertise. Endoscopic dacryocystorhinostomy using the mucosal flap technique is recommended when the surgeon is adequately trained.

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