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Prospective Comparison of Conventional External Dacryocystorhinostomy and Endonasal Laser Dacryocystorhinostomy

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Abstract:

Background: *Epiphora, a common manifestation of chronic dacryocystitis, requires definitive treatment through dacryocystorhinostomy (DCR), a surgical procedure aimed at creating an alternative fluid drainage pathway. This study aimed to assess how effective both external dacryocystorhinostomy (Ex-DCR) and endonasal dacryocystorhinostomy (Endo-DCR) are in managing chronic dacryocystitis, with a specific focus on surgical duration, complication rates, and treatment outcomes.*

Materials & Method: *In this study, sixty participants were prospectively enrolled and evenly divided into two groups. Thirty patients were assigned to the first group and underwent En-DCR surgery, while the second group, also comprising thirty patients, underwent Ex-DCR surgery. Both groups were monitored for a duration of 9 months and assessed for surgical duration, perioperative and postoperative complications, and eventual surgical outcomes.*

Results: *The distribution of patients across age groups and sexes was similar between the two groups (p>0.05). Clinical features such as epiphora, epiphora with discharge, and epiphora with swelling were comparable between groups. En-DCR group demonstrated significantly less intraoperative bleeding (mean:13.5 ml vs 50 ml; p<0.0001) and shorter operative durations (mean: 20 mins vs 37.5 mins; p<0.0001) compared to Ex-DCR group. Complications such as nasal bleeding and hematoma were minimal in both groups, with no significant differences noted. The final outcome, categorized as success (En-DCR vs Ex-DCR: 76.7% vs 83.3%) or failure (23.3% vs 16.7%), did not show a statistically significant difference between the two groups (p>0.05).*

Conclusion: *Both surgical techniques offer feasible alternatives for addressing issues related to nasolacrimal obstruction.*

Keywords: *lacrimal sac, epiphora, chronic dacryocystitis, external dacryocystorhinostomy, endonasal dacryocystorhinostomy*

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Introduction:

Chronic dacryocystitis, which is the chronic infection of either the lacrimal sac or nasolacrimal duct, results in permanent occlusion of the duct. Due to blocked ducts, tears can't drain properly. Excessive tearing, also known as epiphora, is the predominant factor leading to the obstruction of the nasolacrimal duct or the development of chronic dacryocystitis. The definitive approach to addressing obstruction of the nasolacrimal duct is the surgical procedure known as Dacryocystorhinostomy (DCR). Dacryocystorhinostomy is a surgical intervention implemented to address nasolacrimal duct obstruction. It has two approaches- External Dacryocystorhinostomy (Ex-DCR) and Endonasal Dacryocystorhinostomy (En-DCR). The method of performing External DCR was first recorded in 1904 by the Italian surgeon Addeo Toti. In 1921 [1], Dupuy-Dutemps made modifications to this technique by incorporating the suturing of mucosal flaps, resulting in the formation of a fistula lined with epithelium [2]. The endonasal approach, despite being introduced during the early 19th century, has not garnered significant acclaim primarily due to the limited accessibility of the surgical site via the nasal cavity.

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However, the advent of the nasal endoscope in 1986 and the incorporation of endo laser technology have motivated numerous ophthalmologists, plastic surgeons, and rhinologists to embrace this procedure[3-4].

Some research has demonstrated that external dacryocystorhinostomy (DCR) exhibits a higher rate of success, with no notable variances in comparison to Endonasal DCR. However, the mean duration of the surgical procedure is considerably reduced in endonasal DCR.

This study aims to compare these two surgical approaches focusing on the procedure, invasiveness, outcome, and complications. However, these insights are important to clinicians, researchers, and ophthalmologists as they come up with the ongoing improvement of surgical procedures for treating nasolacrimal duct obstruction. We present a comparison of success rates for external DCR and endonasal laser dacryocystorhinostomy in a Bangladeshi tertiary hospital. The study aimed to compare the effectiveness, complication rates and outcome between conventional external dacryocystorhinostomy (EXT-DCR) and endonasal laser dacryocystorhinostomy (ENL-DCR) procedures for treating nasolacrimal duct obstruction, with the goal of providing evidence-based recommendations for selecting the most appropriate surgical approach.

Methods:

Design: prospective, comparative, interventional study.

Settings: This study was conducted in the Department of Ophthalmology, Sylhet MAG Osmani Medical College Hospital, Sylhet from 1st January, 2009 to 31st December, 2010. The targeted population was patients with chronic dacryocystitis.

Inclusion Criteria: All cases of acquired chronic dacryocystitis with confirmed nasolacrimal duct obstruction were included in the study. Both male and female patients aged 20 to 55 years were eligible for inclusion. Patients presenting with canalicular and punctal obstructions, ectropion or entropion, congenital lacrimal apparatus deformities, craniofacial anomalies, lacrimal apparatus and nasal cavity tumors, and those experiencing recurrence following unsuccessful external dacryocystorhinostomy were excluded from the study.

A total of 60 patients were included in this study. The study's goals, nature, and aims were described, and patients provided informed written consent in writing.

In every patient enrolled in this study, the identification of lacrimal obstruction beyond the common canaliculus was established through dacryocystography. Prior to surgery, a comprehensive ophthalmic and otolaryngological evaluation was conducted in all patients, with confirmation of lacrimal obstruction attained through lacrimal irrigation assessment. Every odds number were included in group A (Endonasal Laser assisted Dacryocystorhinostomy) and even number were included in group B (External decryo-cystorhinostomy)

Surgical procedure:

External DCR was performed under general anesthesia with additional local anesthesia administered to the region of the lacrimal sac and nasal mucosa. The procedure commenced with an external incision made adjacent to the medial canthus, followed by meticulous dissection through the subcutaneous tissues to expose the lacrimal sac.

An L-shaped incision was utilized to create the nasal flap and a U-shaped incision for the sac flap . These flaps were meticulously dissected to ensure optimal exposure of the lacrimal bone. Subsequently, a single anterior flap anastomosis was performed, while both posterior flaps were excised. The DCR tube was typically removed 4 weeks post-surgery, followed by SPT to assess patency.

Postoperatively, the patient was monitored for complications and prescribed antibiotics and nasal saline irrigations for healing. Follow-up appointments were scheduled to assess recovery and lacrimal drainage function.

Endonasal Laser-Assisted Dacryocystorhinostomy (ENDL-DCR) was also performed with the patient under general anesthesia. Local anesthesia was administered to the nasal mucosa and lacrimal sac area. Using a nasal speculum, the nasal cavity was accessed, and the inferior turbinate was adjusted for better visualization. A mucosal incision was made along the inferior aspect of the nasal mucosa near the inferior turbinate, allowing access to the lacrimal sac. Nd:YAG laser was utilized to create a bony ostium between the lacrimal sac and the nasal cavity, providing a pathway for tear drainage. The nasal mucosal flap was then repositioned over the ostium to

prevent scarring and closure and meticulous attention was paid to the alignment and positioning of the flap to minimize any potential obstruction. Additionally, intraoperative visualization and confirmation of adequate ostium size were performed using endoscopic guidance.. Absorbable sutures were used to close the incision, and nasal packing was applied to control bleeding. Silicone tubes were not utilized in the Endolaser DCR procedure. Postoperatively, the patient was monitored for complications and prescribed antibiotics and nasal saline irrigations for healing. Follow-up appointments were scheduled to assess recovery and lacrimal drainage function.

Both modules of surgery were performed by the same surgeon. Both groups underwent follow-up assessments in the initial month (on the 1st and 7th post-operative days) and then transitioned to follow-up evaluations at the end of the 1st, 3rd, 6th, and 9th months. These evaluations encompassed subjective assessments of epiphora symptoms and objective examinations of nasolacrimal passage patency via Sac Patency Test (SPT). Systemic medications were phased out after the first week, followed by the cessation of topical ophthalmic medications by the end of the third week. Comparative analyses between groups involved intricate evaluations of surgical duration, perioperative and postoperative complication rates, and six-month outcomes.

Statistical analysis

Descriptive statistics of the study variables were calculated as a part of exploratory data analysis. The arithmetic mean and standard deviation were employed to summarize the statistics of the continuously distributed variables. The distribution of categorical variables was described using frequencies and percentages.

Between-group comparisons executed through an unpaired t test and between categorical variables by chi square test. A bar chart was utilized to present the final outcome comparison between the two groups. All the tests were performed at 5% level of significance. Statistical analyses were performed utilizing IBM's SPSS software (Version 22), USA.

Ethics approval and consent to participate

This study was approved by institutional ethical review board of Sylhet MAG Osmani medical College, Sylhet, Bangladesh. Written consent was obtained from participants, and all methods were performed in accordance with the relevant guidelines and regulations by including a statement in the methods section.

Results:

The age and sex distribution of patients has been presented in Table I and Table II respectively. The majority of participants belong to age group 31-50. More than three-fifth of participants were female.

Table III and IV displays distribution of patients based on clinical features, side of involvement and duration of symptoms respectively. Epiphora was present in all patients, followed by Epiphora with discharge and Epiphora with swelling. The predominant involvement was on left side in both group. The duration (in years)

Table-I

Distribution of the patients on age group

Age group	Total (n=60)	Study group Group-A Frequency (%) (n=30)	Group-B Frequency (%) (n=30)	χ^2	P Value
18-20 years	2 (3.3)	2 (6.7)	0 (0.0)	3.660	p>0.05
21-30 years	8 (13.3)	4 (13.3)	4(13.3)		
31-40 years	17(28.3)	9(30.0)	8(26.7)		
41-50 years	19(31.7)	7(23.3)	12(40.0)		
51-60 years	14(23.3)	8(26.7)	6(20.0)		
Total	60(100.0)	30(100.0)	30(100.0)		

Table-II

Distribution of patients' according to sex

Study Group	Sex		χ^2	p value
	Male Frequency (%)	Female Frequency (%)		
Group-A (n=30)	7 (23.3)	23 (76.7)	0.0982	0.754
Group-B (n=30)	6 (20.0)	24 (80.0)		
31-40 years	13(21.7)	47(78.3)		

Table-III

Distribution of patients by clinical feature

Clinical Feature	Group-A (n=30) Frequency (%)	Group-B (n=30) Frequency (%)	χ^2	p Value
Epiphora	30(100.0)	30 (100.0)	0.6634	0.7176
Epiphora With discharge	25 (83.3)	23 (76.7)		
Epiphora With Swelling	17 (56.7)	22 (73.3)		

Table-IV

Distribution of patients by side of involvement

Laterality	Total	Study group Group-A (n=30) Frequency (%)	Group-B (n=30) Frequency (%)
Left	33 (55.0)	16 (53.3)	17 (56.7)
Right	27 (45.0)	14 (46.7)	13 (43.3)
Total	60 (100.0)	30 (100.0)	30 (100.0)

of symptoms was longer in Group 1 compare to Group 2 (Mean ±SD: 2.6 ±0.6 vs. 2.2 ±1.0; p=0.032) (Table V).

Regarding perioperative bleeding Ex-DCR group has significantly higher amount (in ml) of bleeding (50 ± 8.3 vs. 13.5 ± 3.3; p <0.0001) and longer operation time (20 ± 4.1 vs. 37.5 ± 3.6; p<0.0001) compared to Endolaser DCR (Table VI and VII).

On the first day after surgery, complications included nasal bleeding and hematoma. By the 7th day post-operation, additional complications observed were nasal bleeding, watering, poor wound healing, wound infection, and non-patent sac. At the end of the first month, watering, discharge, non-patent sac, and skin scar were observed. These complications were more prevalent in the External DCR (Ex-DCR) group. By the end of the 3rd, 6th, and 9th months, complications including watering, discharge, and non-patent sac were observed. With the exception of scarring, these complications were more common in the Endolaser-DCR group [Table VIII].

The overall success rate was slightly higher in the Ex-DCR (83.3% vs. 76.7%) group, as shown in Figure 1. However, this difference did not reach statistical significance (p=0.518), as indicated in Table IX.

Table-V

Distribution of patients by duration of symptom

Study Group	Duration of symptom in years		t	df	95% CI	p Value
	Mean	Standard deviation	2.1870	58	0.0339 to 0.7661	0.0328
Group-A (n=30)	2.6	±0.06				
Group-B (n=30)	2.2	1.0				

Table-VI

Distribution of patients by amount of peroperative bleeding

Study Group	Amount of peroperative bleeding in ml		t	df	95% CI	p Value
	Mean	Standard deviation	22.38	58	-39.76 to -33.23	<0.0001
Group-A (n=30)	13.5	3.3				
Group-B (n=30)	50.0	8.3				

Table-VII

Distribution of patients by duration of operative procedure

Operation Time	Study group		t	df	95% CI	p value
(Minutes)	Group-A (n=30)	Group-B (n=30)	17.56	58	-19.494 to -15.506	<0.0001
(Mean SD)	20.0± 4.1	37.5 ±3.6				

Table-VIII

Distribution of patients by complication according to postoperative day

Complication at 1st POD	Group-A (n=30)Frequency (%)	Group-B (n=30)Frequency (%)
Nasal bleeding	1 (3.3)	3 (10.0)
Haematoma	0(0.0)	0(0.0)
Complication at 7th POD	Group-A (n=30)Frequency (%)	Group-B (n=30)Frequency (%)
Nasal bleeding	0(0.0)	1(3.3)
Watering	0(0.0)	2(6.7)
Poor Wound healing	0(0.0)	2(6.7)
Wound infection	0(0.0)	2(6.7)
Non-patent sac	0(0.0)	0(0.0)
Complication at 1st month	Group-A (n=30)Frequency (%)	Group-B (n=30)Frequency (%)
Watering	0(0.0)	0(0.0)
Discharge	0(0.0)	0(0.0)
Non-patent sac	0(0.0)	0(0.0)
Skin scar	0(0.0)	2(6.7)
Complication at 3rd month	Group-A (n=30)Frequency (%)	Group-B (n=30)Frequency (%)
Watering	2(6.7)	1(3.3)
Discharge	2(6.7)	1(3.3)
Non-patent sac	2(6.7)	1(3.3)
Skin scar	0(0.0)	4(13.3)
Complication at 6th month	Group-A (n=30)Frequency (%)	Group-B (n=30)Frequency (%)
Watering	5(16.7)	3(10.0)
Discharge	5(16.7)	3(10.0)
Non-patent sac	5(16.7)	3(10.0)
Skin scar	0(0.0)	4(13.3)
Complication at 9th month	Group-A (n=30)Frequency (%)	Group-B (n=30)Frequency (%)
Watering	7(23.3)	5(16.7)
Discharge	7(23.3)	5(16.7)
Non-patent sac	7(23.3)	5(16.7)
Skin scar	0(0.0)	4(13.3)

Table-IX

Distribution of patients by final outcome

Outcome	Group-A (n=30) Frequency (%)	Group-B (n=30) Frequency (%)	χ^2	p Value
Success	23(76.7)	25(83.3)	0.4167	0.518605
Failure	7(23.3)	5(16.7)		

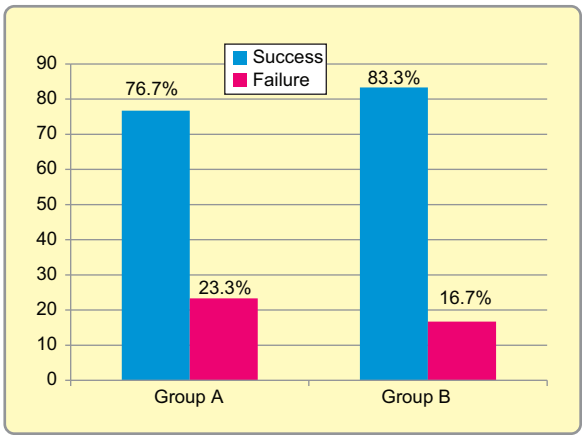

Figure-1: *Success rates of endonasal laser DCR and external DCR*

Discussion:

The best surgery for chronic dacryocystitis is Dacryocystorhinostomy. Various surgical procedures have been used to treat nasolacrimal duct blockage, with different degrees of success and problems. These procedures include the conventional external DCR, endoscopic and non-endoscopic endonasal DCR and dacryocystoplasty[5].

In this study, a total of 60 patients with chronic dacryocystitis participated: 21.7% were male and 78.3% were female. The mean duration of operation was 20 (± 4.1) minutes in endonasal laser DCR and 37.5 (± 3.6) minutes in external DCR. The variance was statistically significant ($P < 0.001$). Hartikainen (1998) found that external DCR surgery took an average of 78 minutes (±12.8) and endonasal laser DCR took 23 minutes (±5.7). The difference was of statistical significance ($P<0.0001$)[6]. Another study by Muscatello L.[7] illustrated that the typical duration of endoscopic dacryo-cystorhinostomy (DCR) procedures lasted 30 minutes on average, ranging from 15 to 110 minutes, with a decreasing trend in time as surgical proficiency increased.

In the present study, we studied the success rates of external and endonasal laser dacryocystorhinostomy (DCR). The overall success rate for endonasal laser dacryocystorhinostomy was 76.7%, whereas external DCR was 83.3%. Though in this study, a slightly higher success rate was found in patients with external DCR than endonasal laser DCR, the difference was not statistically significant ($p > 0.05$). Some of the other published studies have similar success rates to those obtained from our study. According to Duwal and Saiju, external dacryocystorhinostomy demonstrates a 94.1% efficacy rate, whereas endoscopic endonasal dacryocystorhinostomy exhibits a 90.3% success rate six months postoperatively. Overall, the success rate was 92.3%, and the difference between the two groups was statistically insignificant[5]. Hartikainen et al. 1998 found that external DCR had a 91% success rate while endonasal laser DCR had a 63% success rate. The contrast between the groups reached statistical significance [6]. However, Ben Simon et al. revealed endoscopic DCR demonstrated a higher success rate than external DCR[8]. A cochrane review concluded that there exists uncertainty regarding the comparative effects of endonasal and external DCR. Disparities in observed effects could stem from variances in the endonasal technique[9].

The prevailing view among most authors is that external DCR is deemed more technically straightforward owing to its ability to offer an unimpeded visual field and well-defined anatomical landmarks conducive to creating a substantial bone aperture. Additionally, the utilization of mucosal flaps enables the creation of an epithelialized DCR tract. However, developments in endoscopic endonasal DCR have various advantages, including the lack of a skin incision, which minimizes the likelihood of associated problems. Moreover, it safeguards the pump function of the orbicularis oculi muscle and reduces bleeding[10-12]. The endoscopic endonasal technique also demonstrated the ability to correct both nasal and

paranasal sinus problems simultaneously, while also minimizing tissue damage at the osteotomy site and facilitating a more rapid rehabilitation process[13,14].

In this study, patients of Ex-DCR group had significantly higher peroperative bleeding than patients who underwent En-DCR. Similar findings were reported by Mohammad T Rajabi et al.[15] and Khan et al.[16]. In this study, postoperative complications observed following surgery comprised nasal bleeding, wound infection, suboptimal wound healing, excessive tearing, obstruction of the lacrimal sac, formation of a visible scar on the skin, and epiphora. On the 1st post-operative day, nasal bleeding occurred in 3 (10%) cases undergoing external dacryocystorhinostomy. On the 7th post-operative day, watering, poor wound healing, and wound infection occurred in 2 (6.7%) cases undergoing external dacryocystorhinostomy. In the external DCR group, skin scars developed in 4 (13.3%) after 6 months of surgery. Other complications, including watering, non-patent sac, and discharge, occurred in 5 (16.7%) cases undergoing external DCR and 3 (10%) cases undergoing endonasal laser DCR.

In our study, skin scarring was the only complication that developed in the external DCR group. This consequence occurred because there was a required skin incision and a risk of further tissue damage. The incidence of complications caused by endonasal laser DCR was low in our study and took a shorter time to operate than external DCR. Earlier research has also documented a decreased incidence of complications in the endoscopic DCR cohort, characterized by minimal morbidity and shorter operative durations when compared to the external approach[17, 18].

Failure in dacryocystorhinostomy (DCR) procedures can result from various factors, including anatomical variations, technical challenges, and postoperative complications. Anatomical variations such as narrow nasal passages or extensive scarring can impede surgical access and hinder successful outcomes. Technical challenges, such as incomplete bony removal or inadequate mucosal flaps, may compromise the establishment of a patent lacrimal drainage pathway. Additionally, postoperative complications such as infection, granuloma formation, or synechiae can lead to surgical failure[19].

To minimize the risk of failure, careful patient selection and preoperative assessment are paramount. Advanced imaging techniques, such as computed tomography (CT) or magnetic resonance imaging (MRI), can help identify anatomical variations and guide surgical planning. During the procedure, meticulous surgical technique, including complete bony removal and precise mucosal flap creation, is essential for optimal outcomes. Postoperatively, close monitoring for signs of infection or inflammation and prompt management of complications are crucial to prevent failure[20].

The value of long-term data cannot be overstated. Our study provides evidence on the long-term outcomes of both conventional and endonasal laser DCR, which are crucial for understanding the prolonged impact of these interventions. Such data are essential for clinicians when considering the long-term benefits and risks of these surgical options.

The implications of our findings are significant for current clinical practice. The demonstrated effectiveness and safety of both conventional and endonasal laser DCR support their continued use and provide a basis for further innovation and refinement in the field of lacrimal surgery. Additionally, our study highlights the need for ongoing monitoring and follow-up in patients undergoing these procedures, informing guidelines and best practices.

Building on our results, future research should focus on several key areas, including comparing newer techniques or technologies in endonasal DCR, investigating patient-specific factors that influence outcomes, and conducting long-term comparative studies of surgical techniques across diverse populations. Continued investigation in these areas will be essential for advancing the field and improving patient outcomes.

Conclusion

Dacryocystorhinostomy (DCR) stands as the preferred therapeutic approach for addressing nasolacrimal duct obstruction. Across various studies, comparable results are observed between external and endoscopic surgeries, both characterized by low complication rates. Notably, endoscopic procedures offer the unique benefit of leaving no visible scarring and maintaining the integrity of the lacrimal pump system, setting them apart from traditional external DCR approaches.To ascertain whether endonasal DCR achieves success rates comparable to external DCR, future studies should

include well-matched groups undergoing both procedures, alongside clearly defined outcome metrics and robust power analysis.

Conflict of Interest Statement: The author(s) declare(s) that there are no financial or non-financial conflicts of interest related to this study.

Authors' contributions

FA contributed to data acquisition, conception and design of the study, data analysis, data interpretation and manuscript writing. MA and PS contributed to all the stages of development of the manuscript, including data analysis, report writing, writing the draft and revising the final manuscript. ANB, IAM and IAS contributed to the report writing and revising the manuscript. All authors have approved the submitted version of the manuscript.

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