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Success Rate of Combined Transcanalicular Diode Laser and Endoscopic Dacryocystorhinostomy in Patients of Nasolacrimal Duct Obstruction

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ABSTRACT

Objective: To determine the success rate of combined Endoscopic Dacryocystorhinostomy (DCR) and Transcanalicular Diode Laser DCR in patients with nasolacrimal duct obstruction.
Study Design: Analytical cross-sectional study.
Place and Duration of Study: Armed Forces Institute of Ophthalmology, Rawalpindi Pakistan, from March 2024 to Mar 2025.
Methodology: Patients presenting with epiphora and a positive regurgitation-on-pressure test were enrolled through convenience sampling. Pre-sac patency was assessed using lacrimal syringing, which confirmed complete nasolacrimal duct obstruction. All patients underwent combined Transcanalicular Diode Laser DCR and Endoscopic DCR performed as a simultaneous procedure. Outcomes were evaluated at a 6-month postoperative follow-up, assessing overall, anatomical, and functional success.
Results: A total of 150 patients were included, with a mean age of 54.9±9.8 years (range: 28–76 years). The overall success rate was 92.0%, while anatomical and functional success rates were 96.0% and 91.3%, respectively (p=0.016). Functional pathology was the leading cause of failure, and lid laxity (22.7%) was significantly associated with functional failure (23.5% vs 4.3%, p<0.01).
Conclusion: Combined Transcanalicular Diode Laser–Endoscopic DCR yielded high overall, anatomical, and functional success rates. Functional failure remained more common in patients with associated lid laxity.

Keywords: Dacryocystorhinostomy, Endoscopy, Nasolacrimal Duct Obstruction.

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INTRODUCTION

Epiphora, though not sight-threatening, is a distressing symptom that significantly affects patients' quality of life. Nasolacrimal duct obstruction (NLDO) accounts for approximately one-third of all chronic epiphora cases.[1] Dacryocystorhinostomy (DCR) is the standard surgical procedure to re-establish tear drainage from the ocular surface to the nasal cavity.[2] Because the lacrimal system lies at the interface of ophthalmology and otolaryngology, several surgical approaches have evolved over time.[3]

External DCR (ExDCR) involves a skin incision near the lacrimal sac, followed by bony ostium creation and anastomosis between the sac and nasal cavity. Endoscopic DCR (EnDCR), on the other hand, is performed intranasally using an endoscope, thereby avoiding a skin scar.[4] A newer technique, Transcanalicular DCR (TCDL-DCR), employs a 980 nm diode laser transmitted through a fiber-optic probe to create the passage.[5] Reported success rates are 90–95% for ExDCR, 63–94% for EnDCR, and 68.8–83% for TCDL-DCR.[6-8]

Although ExDCR achieves slightly higher success, it is more invasive and associated with greater bleeding, longer operative time, delayed recovery, and a visible scar.[6-9] In contrast, EnDCR and TCDL-DCR are less invasive but may fail due to incomplete sac opening ("lacrimal sump syndrome") or cicatricial closure of the bony ostium.[8-10]

The present study aimed to evaluate the success rate of a combined EnDCR and TCDL-DCR approach, hypothesizing that endoscopic creation of a larger ostium minimizes cicatricial closure, while diode laser guidance ensures precise sac identification and complete opening.

METHODOLOGY

Analytical cross-sectional study was carried out at Armed Forces Institute of Ophthalmology (AFIO) Rawalpindi, Pakistan, from March 2024 to March 2025. Ethical approval was obtained from the Institutional Ethical Review Committee (vide reference letter no.

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338/ERC/AFIO dated 7 March 2024), and written informed consent was taken from all subjects prior to inclusion.

Inclusion Criteria: Adult patients of either gender with complaints of epiphora due to nasolacrimal duct obstruction, a positive regurgitation test, and a patent upper lacrimal system confirmed on syringing were included.

Exclusion Criteria: Subjects with a previous history of failed DCR, prior lacrimal intubation, trauma to the lacrimal system, fistula formation, lid position abnormalities or nasal pathologies that could hinder endoscopic access, and those who were unfit for anesthesia were excluded from the study.

Sample size was calculated using WHO calculator, assuming a previous prevalence of 50%, which yielded a minimum of 96 cases. However, to enhance the reliability of results, a total of 150 subjects were enrolled aged 28 to 76 year.

All patients underwent a complete lacrimal and ophthalmic evaluation, and findings were recorded on a structured proforma. In addition to demographic details, assessment included nasal passage patency using a nasal endoscope (Karl Storz, 4 mm, 30°), regurgitation test, and lacrimal syringing to confirm site and level of obstruction. A full ophthalmic examination was performed, including visual acuity, adnexal evaluation, and anterior and posterior segment assessment, to exclude other ocular pathologies. Detailed adnexal examination was carried out to assess lid laxity, lid apposition, punctal position and patency, conjunctivochalasis, and any additional factors that could contribute to epiphora. One week prior to surgery, subjects were prescribed oral antibiotic (tablet Claritek 250mg BD), enteric-coated oral steroids in minimal dose (depending on patient's weight and co-morbidity control) and nasal decongested spray (xylometazoline hydrochloride 0.1% w/v) thrice a day to prepare the nasal cavity.

After achieving hypotensive general anesthesia, patients were positioned in Reverse Trendelenburg (raising head 30 degrees over feet) to reduce the perioperative bleeding and venous pressure. Nasal cavity, specially between the middle turbinate and lateral nasal wall, was packed with ribbon gauze soaked in a solution of lignocaine plus adrenaline. To enhance further decongestion of nasal mucosa, 1ml of adrenaline in 1:100,000 ratio was injected along the anterior margin of maxillary ridge. After 10 to 15 minutes, nasal pack was removed and nasal endoscope (Karl Storz, 4 mm, 30°) was inserted into the cavity keeping the endoscope bevel towards lateral wall of nose. To reduce nasal mucosal bleed, monopolar cautery (subjects without metallic implants like pacemaker) was used to make the incision in lateral wall of nose. Keeping in mind the location of lacrimal sac, incision was initiated 8 to 10 mm above the axilla of middle turbinate. This superior incision extended 10 mm onto the frontal process of the maxilla (posterior to anterior). The second vertical incision was made on the frontal process down to the insertion of the inferior turbinate. Instead of making the traditional 3rd incision extending from uncinate process to inferior turbinate, authors prefer to make an incision vertically behind the maxillary ridge to divert the nasal mucosa flap inferioposteriorly to cover the middle turbinate. This method avoid injury to posterior nasal mucosa and ensure large and well demarcated bony ostium. Freer periosteum elevator was used to lift mucosal flap from the bone, exposing the frontal process of maxilla and lacrimal bone which is the site for osteotomy. Kerrison rongeurs (both up-bite and down-bite) of both 45° and 90° were used to nibble and remove lacrimal bone and frontal process of maxilla to expose the lacrimal sac and upper part of nasolacrimal duct. Punctum was then dilated with Nettleship punctum dilator and viscoelastic gel was injected into the lacrimal sac through the punctum to lubricate the canalicular system.

Transcanalicular Diode Laser (TCDL) (KLS Martin Diomax diode laser-1550 model) of 980nm wavelength was set to power of 5 Watt in Pulse mode, pulse duration of 2 seconds and pulse pause of 0.4 seconds. Fibre optic probe of 600 µm was inserted via lower canaliculus and after achieving hard stop, it was angled vertically downward, medially and backward to direct towards lacrimal sac. Nasal endoscope was used to visualize the laser glow of pilot beam of TCDL. 2.4 mm angled keratome (Mani Ophthalmic Knife) was then used to make a vertical and horizontal incision along the whole length of lacrimal sac. TCDL was then applied along the whole length of incised edges of the lacrimal sac to avoid adhesions or formation of synechiae. Bicanalicular lacrimal intubation was then placed for 2 to 3 months and fixed to lateral wall of anterior nares in all subjects with Vicryl 6.0. Triamcinolone (40mg/ml) sponge stone pack is then placed at the site of ostium and nasal cavity is packed with lignocaine-adrenaline-soaked gauze for 24 hours.

Patients were prescribed tablet Amoxycillin-Clavulanic acid (625mg 8 hourly) and tablet Diclofenac Sodium (50mg 8 hourly) for 5 days, Oxymetazoline nasal spray twice daily in sitting position, and topical tobramycin with dexamethasone for 2 weeks. Patients were also advised nasal douching and not to blow their nose or rub their eyes. Follow up was on 1st postoperative day, 2 weeks after the surgery and finally six months after surgery. Syringing and irrigation with Triamcinolone (40mg/ml) and 0.01% Mitomycin-C was performed after two weeks of surgery and at final follow-up visit. Anatomical success was determined as negative regurgitation test and free flow of fluid in throat on syringing and irrigation at final follow-up visit. Functional success was determined as absence of epiphora or discharge at final follow- up visit.

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 20. Descriptive statistics were calculated for demographic variables such as age, gender, and laterality, and results were expressed as Mean±SD for quantitative variables and as frequencies and percentages for categorical variables. Success rates (overall, anatomical, and functional) were determined, and causes of failure were summarized. The difference between anatomical and functional success was analyzed using McNemar's test, while agreement between the two was assessed with Cohen's Kappa statistic. Associations between gender, laterality, and outcomes were evaluated using the Chi-square test. The relationship between lid laxity and functional failure was assessed using Chi-square/Fisher's Exact test. A *p*-value ≤0.05 was considered statistically significant.

RESULTS

A total of 150 patients (171 eyes) were included in the study, with a mean age of 54.9±9.8 years (range: 28–76 years). There were 81 males (54%) and 69 females (46%). Nasolacrimal duct obstruction was unilateral in 129 patients (71 right, 58 left) and bilateral in 21 patients. The success rate of TCDL-EnDCR can be seen in Table-I.

Table-I: Surgical outcomes following Transcanalicular Diode Laser-Endoscopic Dacryocystorhinostomy (n = 150)

Outcome	Success n (%)	Failure n (%)
Anatomical success	144 (96.0%)	6 (4.0%)
Functional success	137 (91.3%)	13 (8.7%)
Overall success	138 (92.0%)	12 (8.0%)

Table-II: Association Between Anatomical and Functional Success (n = 150)

Anatomical	Functional		*p*-value	Cohen's Kappa
	Failure n (%)	Success n (%)		
Failure	6(46.2%)	0(0.0%)	<0.001	0.61
Success	137(91.3%)	137(100.0%)		

As shown in Table-II, McNemar's test demonstrated a statistically significant difference between anatomical and functional success (p=0.016), indicating that functional success was modestly lower than anatomical success.

Despite this difference, Cohen's Kappa analysis revealed substantial agreement between anatomical and functional outcomes (κ=0.61, p<0.001), suggesting that most patients with anatomical patency also experienced symptomatic improvement.

As presented in Table-III, patients without lid laxity demonstrated a significantly higher functional success rate (95.7%) compared to those with lid laxity (76.5%), indicating that lid laxity was a strong predictor of functional failure following TCDL-EnDCR.

Table-III: Association Between Lid Laxity and Functional Success (n = 150)

Lid Laxity	Functional Failure n (%)	Functional Success n (%)	*p*-value
Present (n = 34)	8(23.5%)	26(76.5%)	**<0.001**
Absent (n = 116)	5(4.3%)	111(95.7%)	

As presented in Table-IV, there was no statistically significant association between gender or laterality and surgical outcomes, indicating that anatomical and functional success were comparable across males and females, as well as between right, left, and bilateral cases.

Failure occurred in 12 patients (8.0%). The most common cause was functional pathology (50%), followed by nasal mucosal growth (33.3%) and bony/ostium pathology (16.7%), as illustrated in Figure-1.

DISCUSSION

Our study demonstrates that the combined Transcanalicular diode laser–endoscopic DCR (TCDL-EnDCR) yields excellent outcomes: anatomical patency in 96% and symptomatic (functional) success in 91.3%, giving an overall success rate of 92%. These results are in line with published outcomes for endoscopic DCR (ranging 82–98%) and show that the

hybrid laser-assisted approach is a strong contender to conventional methods.[11]

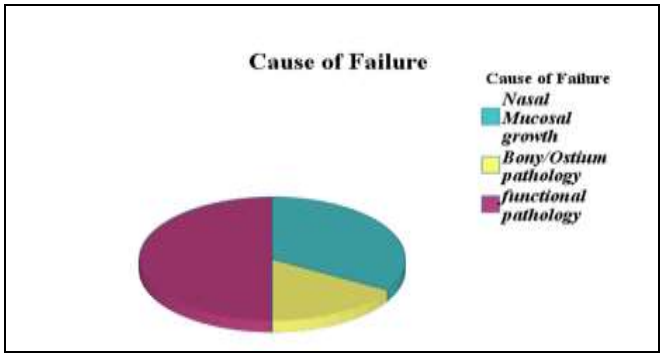

Figure-1: Causes of Failure of Transcanalicular Diode Laser-Endoscopic Dacryocystorhinostomy (n=150)

approaching those of external DCR (96–97%).[14,15] The combined TCDL-EnDCR technique leverages the precision and hemostasis of diode laser ablation with the anatomical accuracy of endoscopic visualization. The laser minimizes intraoperative bleeding, while endoscopy ensures controlled osteotomy and direct mucosal apposition. Together, these advantages enhance both surgical precision and postoperative outcomes.

Compared with external DCR, the hybrid approach avoids an external scar, preserves medial canthal anatomy, and allows simultaneous correction of sinonasal pathologies. However, its success still depends on the learning curve, the adequacy of the osteotomy, and meticulous postoperative nasal care.

Table-IV: Associations Between Patient Characteristics and Surgical Outcomes (n = 150)

Characteristic	Category	Anatomical Success n (%)	Anatomical Failure n (%)	Functional Success n (%)	Functional Failure n (%)	*p*-value*
Gender	Male (n=81)	78(96.3%)	3(3.7%)	74(91.4%)	7(8.6%)	0.85
	Female(n=69)	66(95.7%)	3(4.3%)	63(91.3%)	6(8.7%)	0.79
Laterality	Right (n=71)	68(95.8%)	3(4.2%)	65(91.5%)	6(8.5%)	0.92
	Left (n=58)	56(96.6%)	2(3.4%)	53(91.4%)	5(8.6%)	0.95
	Bilateral (n=21)	20 (95.2%)	1 (4.8%)	19 (90.5%)	2 (9.5%)	0.87

**p-value: Chi-square test for categorical variables (gender, laterality)*

As with many DCR studies, we found that anatomical success exceeded functional success (p=0.016, McNemar's test). A small proportion of patients continued to experience epiphora despite a patent ostium. This phenomenon — "functional failure" — is well reported, with Sung *et al.*, noting functional failure in up to 18.9% of patients after endoscopic DCR.[12] Our Kappa agreement of 0.61 suggests that in most cases, anatomical patency correlates with symptom relief, but not always. This underscores that DCR surgery is not only about anatomical patency but also about functional restoration of the lacrimal drainage system. In our study, lid laxity was found in 22.7% of patients, and functional failure was significantly higher in this group (23.5% vs 4.3%; χ^2=12.27, p<0.001). Similar findings have been reported by Shams *et al.*, who demonstrated improved outcomes when lower eyelid tightening was combined with DCR in patients with functional epiphora.[13] These findings highlight the importance of preoperative oculoplastic evaluation to identify mechanical factors contributing to postoperative epiphora. Reported success rates in literature vary based on technique, surgeon experience, and postoperative care. Endoscopic DCR alone has reported success rates of 90–95%, Our overall success rate of 92% compares favorably with other reports of diode laser DCR (80–90%) and conventional endoscopic DCR (88–95%).[16,17]

In addition, recent studies have emphasized the role of nasal and anatomical factors in determining DCR success. Presence of nasal septal deviation or turbinate hypertrophy has been shown to negatively affect surgical outcomes, and preoperative nasal assessment with possible septoplasty is recommended to improve long-term patency.[18] Similarly, adjunctive silicone stenting does not necessarily enhance outcomes and may, in some cases, reduce functional success rates, suggesting that optimal osteotomy and mucosal healing play a greater role than stenting itself.[19]

LIMITATIONS OF STUDY

The limitations of this study include its single-center design and moderate sample size, which may limit external generalizability. Long-term follow-up would help identify delayed restenosis. Future studies incorporating dacryoscintigraphy or optical coherence tomography of the ostium may better correlate anatomical patency with tear flow dynamics.

CONCLUSION

In conclusion, the combined Transcanalicular Diode-Endoscopic Dacryocystorhinostomy (TCDL-EnDCR) is an effective and minimally invasive technique with high

anatomical and functional success, offering excellent cosmetic outcomes.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AAA & SAZN: Conception, study design, drafting the manuscript, approval of the final version to be published.

AR & UUK: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

WRB & SAHN: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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