

Use of Laser for Dacrocystorhinostomy

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Objective: To compare outcomes between conventional external dacrocystorhinostomy (ext DCR) and endonasal laser-assisted DCR (ELADCR).

Design: Prospective randomized trial.

Patients: The study included 210 consecutive patients (244 eyes) referred to hospital eye and ear, nose, and throat clinics.

Main Outcome Measures: Success rates and complications of ext DCR and ELADCR were compared after

lacrimal ducts requiring DCR were randomly chosen and divided into 2 groups (ext DCR and ELADCR).

Results: The success rate was statistically equal in both groups (92.4% for ext DCR and 94.2% for ELADCR); however, morbidity (eg, intraoperative hemorrhage and wound scar) and operation time were less in the ELADCR group.

Conclusion: Preoperative patient consultation for selection of the surgical modality may help select the procedure of choice for each patient with regard to aesthetics, anesthesia, operation time, and costs.

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NASOLACRIMAL DUCT OBSTRUCTION (NLDO) is a fairly common disorder that is clinically characterized by tearing, purulent discharge, and, less often, sterile or infected dacryocystitis. Although medical treatment, including antibiotic therapy, may result in temporary relief of the symptoms, most authors believe that surgical intervention is the treatment of choice to restore patency of the lacrimal outflow system in cases of primary or secondary NLDO.¹

Endonasal dacrocystorhinostomy (DCR) was first introduced in 1893 by Caldwell² and then later modified. Conventional external DCR (ext DCR) was described in 1904 by Toti.³ However, the endonasal approach was not widely used because of its technical shortcomings. Therefore, ext DCR was the most widely accepted modality for treatment for almost a century.

The advent of functional endoscopic sinus surgery and manual surgical lasers led to renewed interest in the use of endoscopic or endonasal DCR for treating NLDO. In recent decades, external and endonasal techniques have become the most accepted modalities for the treatment of NLDO.⁴ As experience in endoscopic nasal surgery increases, morbidity decreases and the success rate improves. However,

there is still controversy regarding the advantages and disadvantages of the 2 techniques.^{5,6} It is obvious that procedures with lower complications, higher success rates, shorter operation times, easier application, and better cosmetic results are preferred. New techniques such as endonasal laser-assisted DCR (ELADCR), silicone intubation, endocanalicular laser, and balloon catheter dilation have also recently been introduced.⁷⁻¹⁰ We assessed the use of the endocanalicular diode laser for endonasal DCR to treat NLDO and compared the outcomes of this modality with those of conventional ext DCR.

METHODS

A total of 244 eyes with distal NLDO confirmed preoperatively by clinical and paraclinical findings (including epiphora, discharge, and regurgitation test results [backflow from one irrigated punctum to the other], high-resolution computed tomography, scintigraphy of the nasolacrimal apparatus, and diagnostic telescopic endoscopy of the nose in selected cases) were indicated for DCR (210 patients) and included in the study. The patients, who were randomly divided into 2 groups, ranged in age from 21 to 86 years (mean age, 42 years), and the female-male ratio was 1.7:1.0. From January 1999 to December 2002, one group underwent ext DCR, which was performed by the second author (M.F.), as de-

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Table 1. Predisposing Factors, Signs, and Symptoms of Nasolacrimal Duct Obstruction

Characteristic	No. (%) of Cases
Epiphora	192 (78.6)
Dacryocystitis	106 (43.4)
Allergy and conjunctivitis	28 (11.4)
Sinusitis	27 (11)
Nasal obstruction/ethmoid bulla* and polyposis	24 (9.8)
Septal deviation	21 (8.6)

*Ethmoid bulla is a very large air cell occupying the whole middle turbinate.

scribed by Dupuy-Dutemps and Bourguet,¹¹ and the other group underwent ELADCR, which was performed by the first author (M.A.). Particular attention was paid to intranasal abnormalities and any anatomical predisposing conditions. The exclusion criteria consisted of punctual and canalicular abnormalities, lower eyelid deformities, previous DCR, age younger than 15 years, malignancy, previous radiation therapy, trauma, and bone disease. A successful outcome was defined as elimination of epiphora or dacryocystitis and negative irrigation test result (ie, unrestricted flow of irrigated water to the nose) 1 year after surgery. In bilateral cases (32 patients), each side was considered as a separate operation. The predisposing factors, signs, and symptoms of NLDO are presented in **Table 1**.

SURGICAL TECHNIQUE

For ELADCR, the patients underwent nasal mucosal shrinkage under general anesthesia or sedation, and predisposing factors for NLDO (septal deviation or concha bullosa) were corrected if indicated. Endocanalicular-illuminating fiber or red illumination of the laser fiber helps in pinpointing the lowermost part of the sac (**Figure 1**). The diode laser can be applied through flexible fibers into the canaliculus without harming the lumen. Then, the anterior attachments of the middle turbinate and lacrimal bone are burned out using 10-W diode laser shots for 30 seconds to make a 1×1-cm bony opening (**Figure 2**). In our study, the total energy delivered was estimated to be at least 300 J. This amount of energy is sufficient to raise the temperature to 250°C and to vaporize the lacrimal bone. A laser fiber is then easily passed through 1 canaliculus to reach the medial wall of the sac. Intranasal saline irrigation is used to prevent thermal damage to the adjacent tissues. Using a laser for bone removal is much easier than intranasal drilling. We chose this type of laser instead of the more accepted holmium laser for bone removal because it provides a very thin 0.6-mm fiber that can easily be passed through the extremely narrow lacrimal canaliculus, and energy is released from the contact tip, so iatrogenic trauma to the surrounding tissue is prevented. The laser's characteristics are as follows: wavelength, 800 to 900 nm; power range, 1 to 15 W; and semiconductor contact fiber, 0.6 to 1 mm in diameter.

The ext DCR surgery was performed with the patients under general anesthesia or sedation. A silicone tube was passed through the canaliculi in both groups of patients and kept in place for at least 3 months. Also, iden-

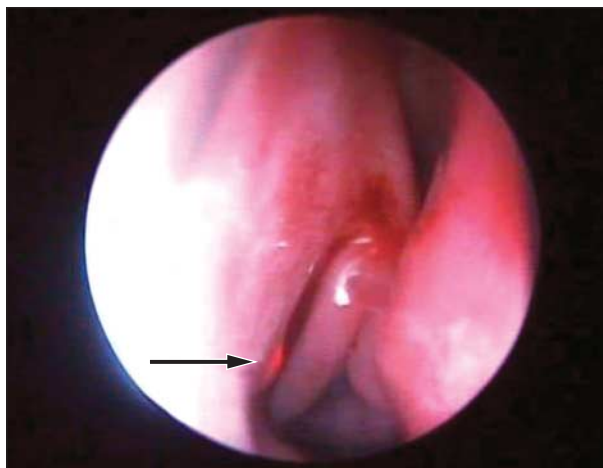


Figure 1. Arrow shows the red beam pinpointing the lowermost part of the sac.

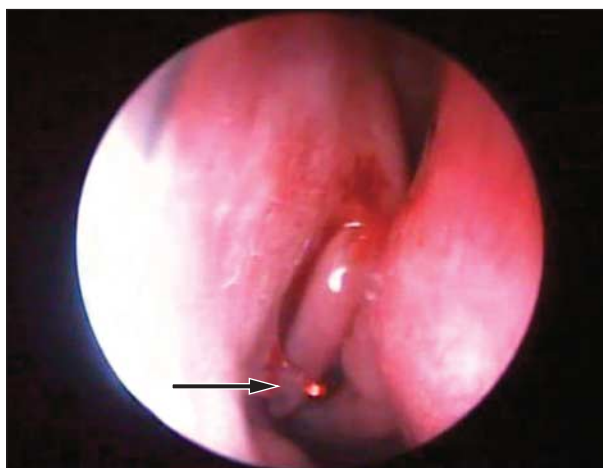


Figure 2. Arrow points to the passage of the laser fiber from the sac to the nose after the lacrimal bone is vaporized.

tical topical antibiotics and steroid drops were prescribed for 1 week in both groups. In cases of nasal anatomical correction, the packing was removed on the third day after surgery. Follow-up consisted of weekly office visits for 1 month, monthly inspections for 3 months until the tube was removed and the canaliculonasal fistula was irrigated, and then office visits every 3 months for 9 more months, with an irrigation test performed at each visit.

RESULTS

The duration of postoperative follow-up was 12 to 36 months (mean, 18 months). As shown in **Table 2**, the success rates in both groups were statistically not significant ($P > .05$). In the ELADCR group 7 cases (5.7%) failed, and in the ext DCR group 9 cases (7.3%) failed. Granulomas in nasal or punctual sites were removed or cauterized with 10% trichloroacetic acid (or treated with betamethasone eye drops in 2 cases). Eyelid edema or hematomas resolved within 1 week. Synechiae between the septum and rhinostomy orifice were not clinically significant. Ten patients in the ext DCR group were con-

Table 2. Morbidity and Success Rates After Dacryocystorhinostomy (DCR)*

Complication	Ext DCR	ELADCR	P Value
Success rate	113 (92.6)	115 (39.4)	.90
Mean operation time, min	61	19	.04
Massive bleeding (intraoperative)	12 (10.0)	2 (1.6)	.05
Massive bleeding (postoperative)	1 (0.8)	1 (0.8)	.98
Poor wound healing (keloid)	10 (8.0)	0	.05
Infection	11 (9.0)	1 (0.8)	.03
Periorbital edema or hematoma	2 (1.6)	4 (3.2)	.07
Punctual trauma	1 (0.8)	3 (2.4)	.07
Synechia	8 (6.5)	10 (0.8)	.06
Granulation tissue	1 (0.8)	1 (0.8)	.98

Abbreviations: ELADCR, endonasal laser-assisted DCR; Ext, external.

*Values other than mean operation time are given as number (percentage).

cerned about scarring; the difference was statistically significant ($P = .03$). Morbidities were more prevalent in the ext DCR group (Table 2). The mean operation time was 19 minutes (range, 11-46 minutes) for ELADCR and 61 minutes for ext DCR. The female-male ratio was nearly equal. Fifteen cases in the first group (ELADCR) and 13 cases in the second group (ext DCR) were known cases of allergy. Ethmoidal and maxillary sinusitis was diagnosed as the predisposing factor in 11% of the patients in each group (Table 1).

COMMENT

Similar to other studies,^{5,11} we found that the majority of the NLDO cases were acquired. The peak age at presentation in our study was the fifth decade of life, whereas it was the fifth to seventh decades of life in the report by Emmerich et al¹² from Germany and the fourth to fifth decades of life in the report by Kunavisarut et al¹³ from Thailand. This difference may reflect the geographic-environmental population structure; however, in most studies, as in ours, epiphora was the most prevalent symptom.

Nasolacrimal duct obstruction should be surgically corrected to relieve its symptoms and signs.¹⁴ In all the described techniques, surgeons attempt to make a permanent fistula between the sac and nasal cavity. Different techniques using curettes, chisels, burrs, lasers, or microscopes for endonasal DCR have been described in the literature, with similar results.^{15,16} External DCR, however, remains the most popular treatment among ophthalmologists.⁵ Success in DCR surgery has different definitions; however, loss of symptoms and entrance of irrigated fluid into the nose is the most accepted one.¹⁷ Using this definition, the success rate in our 2 study groups is in the same range as that noted in previous reports (Table 3).

The advantages of endonasal DCR are shorter operation time, lower morbidity, and less intraoperative hemorrhage.^{21,22} Also, the endonasal approach allows concurrent diagnosis and management of some predisposing or concomitant nasal and paranasal disorders,¹⁷ as it did in 21 cases in the ELADCR group. It can also be per-

Table 3. Review of the Literature on Dacryocystorhinostomy Techniques

Source	No. of Patients	Technique	Success Rate, %
Sprekelsen and Barberan, ¹⁸ 1996	152	Endonasal, burr	96.0
Metson et al, ¹⁹ 1994	46	Endonasal, holmium:YAG	85.0
Pearlman et al, ¹⁵ 1997	46	Endonasal, YAG	85.0
Beigi et al, ²⁰ 1998	242	External	83.5
Massegur et al, ⁶ 2003	96	Endonasal, chisel	92.0
Kashkoui et al, ⁵ 2003	276	External	89.1
Tarbet and Custer, ¹⁷ 1995	169	External	92.0

formed with the patient under local anesthesia or on an outpatient basis. Furthermore, it may be useful in the management of acute dacryocystitis with abscess formation,²³ unlike ext DCR, which is often considered to be contraindicated in this setting.¹¹ The limitations of endonasal DCR have been described as follows: small rhinostoma, high recurrence rate, costly equipment, and difficult to master.²⁴ We made rhinostomas of equal sizes in both groups, and the failure or recurrence rate was the same. Despite the reported disadvantages of ELADCR, the absence of an external scar, short recovery period, minimal morbidity, and low complication rate have made the procedure more acceptable. In our study, we used an inexpensive diode laser that is now available in most multidisciplinary surgical theaters. We did not use telescopes or microscopes, only a headlight. The holmium laser is more commonly used for bone removal, but we found that (1) it could not be passed through a very small canaliculus, (2) it is not very flexible, and (3) its lasing beam may burn the duct and lead to stenosis or obstruction. However, the flexible diode laser fiber heats only at the tip and does not burn or cause stenosis of canaliculi, and it is effective in vaporizing the lacrimal bone.

The only contraindication for the endonasal approach is a suspicion of lacrimal system neoplasia.²³ Maintaining a silicone tube may facilitate epithelial anastomosis and continuous fluid flow to make a patent rhinostoma.¹⁷ However, to our knowledge, a strong relationship between tube retention and success has not been documented.²⁵ Prolonged intubation may even lead to granuloma formation.²⁶ This issue needs to be studied further to define the optimum time for tube removal. In our study, granulation tissue, which was detected in 1 case in each group, responded to tube removal and local treatment. No complete bony closure was observed in failed cases. Rhinostomy site obliteration was the reason for failure in 3 cases of ext DCR and 2 cases of ELADCR. The differences in success rates between the 2 groups were not statistically significant after 6, 9, and 12 months of follow-up ($P = .07$).

To achieve a high rate of success, it is very important to be able to visualize the sac from the fundus to the duct and to remove the whole medial wall, or at least the lowermost part, with or without a laser. Wide openings to the nose allow better results and prevent mucosal closure as well as retention pouches caudal to the rhinos-

tomy. As a literature review of the DCR techniques presented in Table 3 shows, the reported success rates, which are high,^{18,19,26} are similar to ours and confirm the results of our study. Preoperative consultation is warranted to select the procedure of choice for each patient with regard to aesthetics, anesthesia, operation time, and costs.

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