·Clinical Research·

Outcome comparison between transcanalicular and external dacryocystorhinostomy

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Abstract

• AIM: To compare the outcomes achieved with external dacryocystorhinostomy (EX-DCR) and transcanalicular dacryocystorhinostomy (TC-DCR) using a multidiode laser in patients with bilateral nasolacrimal duct obstruction (NLDO).

• METHODS: This prospective study was conducted on 38 eyes of 19 patients with bilateral NLDO. Simultaneous bilateral surgery was performed on all patients. TC-DCR (Group 1) with a diode laser was used in the right eye, and EX-DCR (Group 2) was used in the left eye. All patients were placed under general anesthesia. Routine follow-ups were scheduled at 1wk; 1, 3, 6 and 12mo postoperative intervals. Objective (lacrimal system irrigation) and subjective [tearing, irritation, pain, discharge and visual analogue scale (VAS) score] outcomes were evaluated.

• RESULTS: The overall objective success rate at 12mo was 73.7% (14/19) in Group 1 and 89.5 % (17/19) in Group 2. This difference was statistically significant. There were no significant between-group differences in the subjective results, such as tearing, pain and irritation. Only the discharge scores were found to be significantly higher in Group 1 compared to Group 2 at the 1y follow-up. The average VAS score was 6.8 in Group 1 and 8.7 in Group 2, with no statistically significant differences.

• CONCLUSION: Although TC-DCR allows surgeons to perform a minimally invasive and safe procedure, EX-DCR offers better objective and subjective outcomes than TC-DCR.

• KEYWORDS: dacryocystorhinostomy; diode lasers; epiphora; lasers; transcanalicular
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INTRODUCTION

External dacryocystorhinostomy (EX-DCR) has been the gold standard procedure for treating nasolacrimal duct obstruction (NLDO) [1,2]. Endonasal dacryocystorhinostomy was first described in 1989 by McDonogh and Meiring[3]. The procedure has gained popularity with the development of nasal endoscopic techniques [4]. Improvements in lasers and laser devices allow surgeons to use minimally invasive techniques, including transcanalicular and endonasal approaches [5,6]. The first transcanalicular laser dacryocystorhinostomy was performed with an argon laser[4]. Today, transcanalicular dacryocystorhinostomy (TC-DCR) with a diode laser has been frequently utilized to treat primary NLDO [7,8]. In the literature, successful results have been reported using TC-DCR method. Although the short-term results of TC-DCR have been reported in previous studies, the long-term results are still unclear. Thus, there is a need to further explore the long-term results of the TC-DCR procedure and perform further comparative studies.

The success of nasolacrimal surgery in the treatment of NLDO can be determined by evaluating both objective and subjective outcomes. Objective outcomes can be assessed with nasolacrimal system irrigation, dacryocystography, dacryoscintigraphy and endoscopic ostium examinations.

The subjective outcomes can be assessed by measuring the improvements in patient symptoms and by evaluating questionnaires [9]. Discrepancies between the objective findings and the patients' subjective complaints have been reported in previous studies[10,11]. Objective outcomes may not always reflect a patient's experience and satisfaction level. For example, patients with an anatomically patent nasolacrimal system may still complain of epiphora [11,12]. Therefore, the experience of the patient and subjective regression of the symptoms should be considered when evaluating the surgical success of NLDO.

The purpose of this study was to compare the objective and subjective outcomes between TC-DCR (using a multidiode laser) and EX-DCR in patients with bilateral NLDO. Our previous study compared the objective and subjective 3mo results of the TC-DCR and EX-DCR methods in patients with bilateral obstruction. Here, we provide the 12mo follow-up results as a continuation of the same study.

SUBJECTS AND METHODS

This prospective study included 38 eyes of 19 patients with bilateral NLDO who underwent simultaneous bilateral surgery between September 2010 and June 2011 at the Ophthalmic Plastic and Reconstructive Surgery Department, Department of Ophthalmology, Istanbul Faculty of Medicine, Istanbul University. Informed consent was obtained from all subjects after the nature and possible consequences of the surgery were explained. The tenets of the Declaration of Helsinki were followed.

Patients with bilateral NLDO who were referred to the ophthalmology clinic with signs and symptoms of NLDO were included in this study. Patients with trauma to the lacrimal system, nasal polyps, severe septal deviation, concha hypertrophy, canalicular obstruction and active lacrimal or sinus infection were excluded from the study.

All patients underwent simultaneous bilateral surgery. TC-DCR was performed in the right eye using a multidiode laser (Group 1) and EX-DCR was performed in the left eye (Group 2). The patients were placed under general anesthesia. First, nasal decongestion was performed, and intranasal anesthesia for vasoconstriction was administered. All surgeries were performed by the same surgeon (Yeniad B).

Using a multidiode laser, TC-DCR was performed in the right eyes of bilateral NLDO patients. Using the TC-DCR technique, the punctum was dilated, and a 600 μm semi-rigid quartz diode laser fiber (Multidiode S30 OFT, Intermedic, Spain) was inserted from the punctum into the lacrimal sac *via* the canaliculus. The nasal cavity was visualized with a 0° 4 mm rigid nasal endoscope during the surgery. The location of the lacrimal sac was identified intranasally using transillumination. The middle turbinate was deviated medially with a periosteal elevator, which allowed visualization of the surgical area. The laser was set at a power of 10 W and a pulse length of 400 ms with a 400 ms pause between the pulses. Under endoscopic guidance, the laser energy was applied inferior and anterior to the root of the middle turbinate until an adequate-sized ostium was created. The lacrimal system was irrigated to confirm the patency of the nasolacrimal system, and a bicanalicular silicon tube was placed.

EX-DCR was performed in the left eyes of patients with bilateral NLDO. A curvilinear incision measuring 1.5 to 2 cm in length was made at the level of the anterior lacrimal crest, avoiding the angular vessels. The orbicularis muscle fibers were separated. The periosteum was incised. The lacrimal sac was separated from the lacrimal fossa. The lamina papyracea was fractured with the periosteal elevator. The lacrimal and maxilla bones were removed with Kerrison rongeurs to create an adequate osteotomy. Anterior and posterior flaps were prepared, and a bicanalicular silicon tube was placed. The anterior and posterior flaps were joined with absorbable 6/0 polyglactin sutures. The orbicularis layers and skin were closed separately with absorbable 6/0 polyglactin sutures. Finally, the lacrimal system was irrigated.

The patients were told to rinse their noses with saline to clear away mucus and debris postoperatively. Tobramycin-dexamethasone eye drops were used 4 times per day for 3wk. Oral antibiotics were used for 7d. The tubes were removed postoperatively at 8wk. A postoperative evaluation was performed with routine follow-ups at 1wk; 1, 3, 6 and 12mo postoperative intervals.

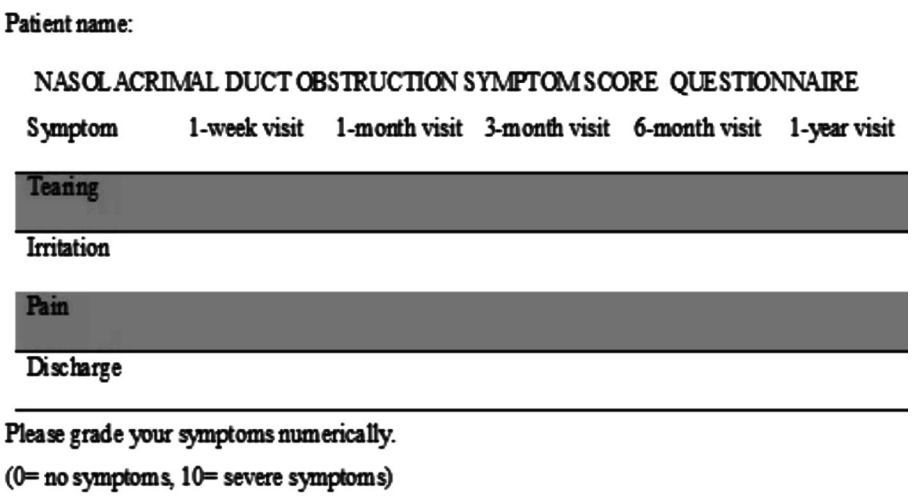
Surgical success was defined by objective and subjective outcomes. The objective outcomes were evaluated by lacrimal system irrigation. A successful objective outcome was defined as the presence of a patent nasolacrimal duct upon nasolacrimal irrigation. We requested that all patients grade their symptoms, including tearing, pain, irritation and discharge, using a numeric rating scale (0-10) for each eye to determine the subjective outcomes. The patients were instructed that a score of 0 indicated no symptoms and a score of 10 indicated the most severe symptoms (Figure 1).

All patients were also asked to complete a questionnaire including the visual analogue scale (VAS), to explore their perception of outcomes and success after surgery (Figure 2). The results from the questionnaires were compared for each eye.

Statistical Analysis Statistical analysis was performed using SPSS Statistics software version 17.0 (SPSS, Inc., Chicago, IL, USA). The symptom scores were compared between Group 1 and Group 2 using the Mann-Whitney *U* test. The Wilcoxon test was used to compare the intra-group differences. McNemar's test was used to compare the success rates of the methods performed on the right and left eyes. Statistical significance was set at $P<0.05$.

RESULTS

The study group included 19 patients (15 females, 4 males) with bilateral NLDO who underwent TC-DCR using a multidiode laser in the right eye (Group 1) and EX-DCR in the left eye (Group 2) during the same surgery. The mean patient age at the time of surgery was 52.4 years old (range, 21 to 59 years old). The mean surgical durations were 21.4±16.8min (17.8-32.6min) for TC-DCR using a multidiode laser and 56.2±21.4min (42.3-82.7min) for EX-DCR.


Patient name:

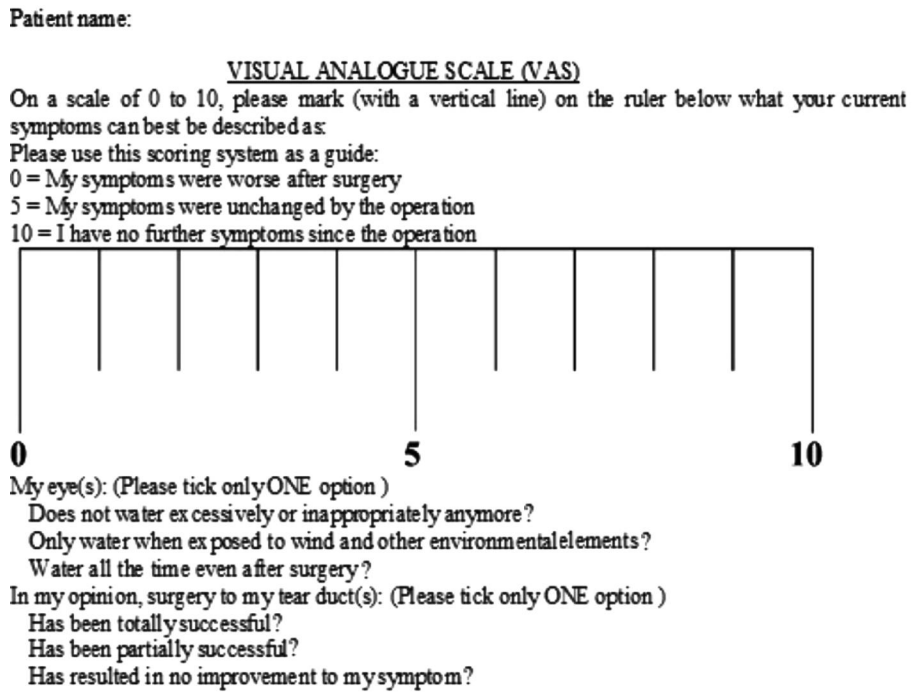
NASOLACRIMAL DUCT OBSTRUCTION SYMPTOM SCORE QUESTIONNAIRE

Symptom	1-week visit	1-month visit	3-month visit	6-month visit	1-year visit
Tearing					
Irritation					
Pain					
Discharge					

Please grade your symptoms numerically.

(0= no symptoms, 10= severe symptoms)

Figure 1 Nasolacrimal duct obstruction symptom score questionnaire.


Patient name:

VISUAL ANALOGUE SCALE (VAS)

On a scale of 0 to 10, please mark (with a vertical line) on the ruler below what your current symptoms can best be described as:

Please use this scoring system as a guide:

0 = My symptoms were worse after surgery

5 = My symptoms were unchanged by the operation

10 = I have no further symptoms since the operation

0 5 10

My eye(s): (Please tick only ONE option)

Does not water excessively or inappropriately anymore?

Only water when exposed to wind and other environmental elements?

Water all the time even after surgery?

In my opinion, surgery to my tear duct(s): (Please tick only ONE option)

Has been totally successful?

Has been partially successful?

Has resulted in no improvement to my symptom?

Figure 2 Visual analogue scale (VAS).

In 3 eyes from Group 2 (EX-DCR), moderate nasal hemorrhages, which were easily controlled by laser coagulation or nasal packing, occurred during the operations. There were no nasal hemorrhages in the eyes of Group 1 (TC-DCR) during the surgery. Postoperatively, only 1 eye in Group 1 (TC-DCR) exhibited moderate posterior nasal hemorrhage, which was controlled by nasal packing. There were no postoperative complications, such as false passage, canalicular damage, orbital hematoma or fat herniation, in either group.

Objective Outcomes Surgical success (nasolacrimal duct patency in a nasolacrimal irrigation) was achieved in 73.7% (14/19) of the eyes of Group 1 (TC-DCR) and 89.5% (17/19) of the eyes in Group 2 (EX-DCR) after 1y. The difference was statistically significant (P=0.017 <0.05). There were 7 failures: 5 occurred in Group 1 and 2 occurred in Group 2. Four of the failed Group 1 cases experienced membrane formation in the common canaliculi and closed nasal ostium. One of the failed cases in Group 1 had closed nasal ostium alone, and two of the failed cases in Group 2 had membrane formation in the common canaliculi alone. Obstruction of the nasal ostium did not occur in any of the eyes in Group 2.

Subjective Outcomes Table 1 compares the four ocular symptom scores (*i.e.* tearing, pain, irritation and discharge) in Group 1 and Group 2 at the 1wk; 1, 3, 6 and 12mo follow-ups. The tearing, pain and irritation scores were not significantly different between the two groups at the 1wk; 1, 3, 6 and 12mo follow-ups (P>0.05).

In the same manner, there was no significant between-group difference in the discharge scores during the 6mo follow-up visit (P>0.05). At the 12mo visit, the discharge scores were significantly higher in Group 1 compared to Group 2 (P= 0.048<0.05). The average VAS score for Group 2 was higher than that for Group 1 at each visit; however, there was no significant difference between the two groups at the 1wk; 1, 3, 6, and 12mo follow-up visits (P>0.05; Figure 3).

Table 1 Comparison of four ocular symptom scores in Group 1 and Group 2 at the 1wk; 1, 3, 6 and 12mo follow-ups

$\bar{x} \pm s$, n=14

Symptoms	Group 1 (TC-DCR)	Group 2 (EX-DCR)	*P*
Tearing			
1wk	2.57 ±3.18	1.79 ±3.26	0.228
1mo	2.64 ±3.37	3.07 ±3.32	0.619
3mo	3.50 ±3.23	2.36 ±2.76	0.194
6mo	3.15 ±2.82	1.46 ±2.30	0.122
12mo	3.50 ±3.56	1.46 ±2.30	0.122
Pain			
1wk	1.93 ±2.87	2.36 ±2.79	0.459
1mo	1.14 ±2.28	1.36 ±2.13	0.786
3mo	0.00 ±0.00	0.21 ±0.58	0.180
6mo	0.00 ±0.00	0.31 ±0.75	0.317
12mo	0.00 ±0.00	0.31 ±0.75	0.317
Irritation			
1wk	1.86 ±2.35	1.57 ±2.74	0.581
1mo	1.86 ±2.71	1.57 ±1.60	0.715
3mo	1.29 ±2.27	0.43 ±1.09	0.144
6mo	0.85 ±1.73	0.23 ±0.60	0.180
12mo	1.08 ±2.06	0.08 ±0.28	0.109
Discharge			
1wk	1.79 ±2.99	1.57 ±2.41	0.655
1mo	2.07 ±2.84	1.29 ±1.94	0.078
3mo	1.71 ±2.09	0.79 ±1.93	0.071
6mo	2.23 ±2.49	1.15 ±2.44	0.121
12mo	2.85 ±2.58	1.31 ±2.43	0.048

DISCUSSION

Laser DCR has been used in endoscopic or transcanalicular manners since the beginning of the 1990s. Various lasers have been used in TC-DCR [13]. The diode laser has been used for coagulation in ophthalmology for some time, it is used in some oculoplastic procedures and in EX-DCR for tissue dissection with modification. This laser is also used in TC-DCR with a high energy system and a fiber-optic laser apparatus [7]. The principle of the multidiode laser, which has been more widely used in the last several years, is based on the absorption of its energy by the target tissue and the translation of this energy into a thermal effect. Thus, a fistula is created between the lacrimal sac and the nasal cavity by making an incision in the mucosa and bone tissue[14].

One advantage of surgical intervention with endonasal and transcanalicular laser DCR is the lower risk of bleeding[15-19]. The cauterization effect of the diode laser in TC-DCR decreases the amount of bleeding and increases the likelihood of good vision during the surgery. The other advantages of TC-DCR include the following: no incision (which alleviates scarring), protection of the lacrimal pump mechanism, and the opportunity for additional endoscopic nasal surgeries[6,7,16].

In the literature, different success rates have been reported with the TC-DCR method. Plaza *et al* [8] reported an 88% success rate for primary NLDO during a 36mo follow-up period, and Hong *et al* [6] reported an 87% success rate for recurrent NLDO. Cakmak and Yildirim [17] also observed an 87.5% success rate for NLDO in children during a 6mo follow-up period. Narioka and Ohashi [16] reported an 80% success rate for failed EX-DCR revision. Uysal *et al* [18] performed a TC-DCR procedure in 20 eyes with congenital NLDO. During a 20mo follow-up period, the anatomical and clinical success rates were 100% and 85%, respectively. In the series of Farzampour *et al* [19], during 12mo follow-up period, the anatomical and clinical success rates of TC-DCR were 81.5% and 74.2% , respectively. Derya *et al* [20] compared the subjective success rates of the EX-DCR and TC-DCR procedures. The authors performed EX-DCR in 29 eyes and TC-DCR in 26 eyes. During an 8mo follow-up period, the subjective success rates of EX-DCR and TC-DCR were found to be 86% and 68%, respectively.

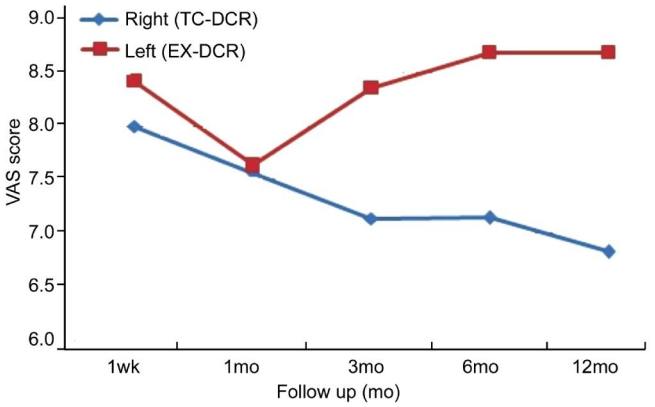


Figure 3 A comparison of the average VAS score between transcanalicular and external DCR over 12mo of follow-up.

Our study reported the objective and subjective results of patients with bilateral duct obstruction who underwent EX-DCR in one eye and TC-DCR in the other eye. At the 3mo follow-up, the anatomical success rates were 84.2% and 89.4% in the TC-DCR and EX-DCR groups, respectively. During the 3mo follow-up period, when the objective and subjective results were compared between the two groups, the difference was not statistically significant[21]. At the end of the 12mo follow-up, the objective success rate was 73.7% in the TC-DCR group and 89.5% in the EX-DCR group. During the 12mo follow-up period, when the objective results were compared between the two groups, the difference was statistically significant; however, these results are not robust due to the small number of cases in the study. Comparable studies with an increased number of patients are needed.

We also aimed to determine and compare the patient satisfaction rates and to determine how the quality of life was affected for the patients undergoing the two different DCR methods in our study. We evaluated the subjective results using a scoring system that included the most common signs and symptoms (tearing, pain, irritation and discharge after the

surgery and VAS). More tearing was observed in the TC-DCR group than in the external group at all postoperative visits. However, this result was not statistically significant. Generally signs of pain (*e.g.* irritation and discharge) were observed more frequently in the EX-DCR group than in the transcanalicular group. However, this difference was also not statistically significant. Only the discharge scores were found to be significantly higher in the TC-DCR group compared to the external group at the 12mo follow-up. In the 12mo follow-up, VAS showed that the patient satisfaction rates were 8.6 and 6.8 in the EX-DCR and TC-DCR groups, respectively. The patients were more satisfied with the EX-DCR; however, this difference was not statistically significant.

This study has some limitations. Inadequacy in the questionnaires and scoring systems can also limit the interpretation of the postoperative subjective results. Therefore, researchers must prepare more detailed questionnaires to determine the postoperative subjective improvement and changes in quality of life.

In conclusion, although TC-DCR is a practical and rapid method, the long-term results are generally worse than those achieved with EX-DCR, the gold standard method. More studies are needed to examine the long-term results and to provide comparative results to determine the efficacy of multidiode laser use in patients with NLDO.

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