Acta Scientific Ophthalmology (ISSN: 2582-3191)

Volume 3 Issue 3 March 2020

Research Article

Endoscopic Endonasal Dacryocystorhinostomy in Persistent Congenital Nasolacrimal Duct Obstructions

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DOI: 10.31080/ASOP.2020.03.0103

Received: February 24, 2020

Published: February 29, 2020

Abstract

Purpose: The purpose of this study is to show the efficiency of endoscopic endonasal dacryocystorhinostomy (EDCR) in children who have a history of failed surgical interventions following recurrent probings.

Methods: EDCR was performed on 19 eyes in 17 patients diagnosed with persistent congenital nasolacrimal duct obstruction who received failed interventions of at least two probings or a silicone tube intubation.

Results: The ages of the 17 patients were between 1.7 years and 5 years (mean = 3.3 years). Regarding sex, 10 patients (58.8%) were male and 7 (41.2%) were female. Surgery was performed on the left eye in nine (53%) cases and on the right eye in six (35%) cases, and in two (12%) cases, bilateral EDCR was performed. The postoperative follow-up time of the cases was between 3 and 46 months (mean = 25.5 months). In all cases except two, findings such as watering and mucopurulent discharge disappeared, and a success rate of 89.4% was achieved.

Conclusion: Persistent CNLDO often undergoes surgical interventions such as repeat probing, silicone intubation, and laser dacryocystorhinostomy as alternative methods. However, EDCR is a preferred and safe surgery in children with persistent CNLDO.

Keywords: Nasolacrimal Duct Obstruction; Persistent Epiphora; Failed Surgical Interventions; Pediatric Endoscopic Dacryocystorhinostomy

Introduction

Spontaneous remission can be seen in congenital nasolacrimal duct obstruction (CNLDO). The use of massage and topical antibiotics without surgical procedures results in 46% resolution by the month 3 and 66% resolution by the month 6 of treatment [1]. In children older than two years, the success of probing can range from 54% to 97.72% [2,3]. While there have been studies demonstrating decreased probing success with increased age [4-6], other studies have shown that success is independent of age [7,8].

In addition to recurrent probings, balloon dacryoplasty, silicone intubation, or endoscopic dacryocystorhinostomy (EDCR) can also be performed. Following unsuccessful probing applications, balloon dacryoplasty or silicone intubation are secondary therapies for CNLDO [9]. Surgical intervention is recommended if there are recurrent infections due to CNLDO, if there are persistent symptoms lasting for more than 6 months, or if conventional therapies are not successful [10].

The EDCR technique is similar between the pediatric age group and adults with various surgical challenges depending upon the age group. Even though surgery is more difficult due to a limited working area resulting from children's narrow nasal passages and relatively larger inferior turbinate as well as the differences in anatomical borders, EDCR can be safely used in children with persistent epiphora who do not respond to conservative therapy [11].

The aim of this study is to show the efficiency of EDCR in patients in children who received failed surgical interventions such as silicone intubation and endocanalicular diode laser dacryocystorhinostomy following recurrent probings.

Methods

A retrospective, case-series was performed on all consecutive children ≤ 12 years of age who underwent failed surgical interventions. EDCR was performed on 19 eyes in 17 patients who had had at least two ineffective probings and were referred to our ophthal-

mology clinic between the years 2007 - 2019 with CNLDO. The study was approved by the Institutional Ethics Committee and adhered to the Declaration of Helsinki.

The patients were diagnosed with CNLDO according to parental history, ophthalmological examination, and previously defined Jones 1 and 2 tests [12]. Before probing, contact was made with the nasal bone using a Bowman probe 00 m (Altomed, Tyne and Wear, England) in the lower canaliculus (hard stop) to observe reflux from the upper canaliculus, which showed that the obstruction was based on post-saccal CNLDO. Patients were assessed by a physician who specializes in otorhinolaryngology in terms of nasal pathologies, such as septum deviation, concha hypertrophy, and craniofacial deformity. Children with craniofacial deformities, with lower canalicular or punctum deformities, or older than 12 years were excluded from the study.

In the 17 patients who were included in this retrospective study, an absence of watering or mucopurulent discharge was considered an indicator of successful endoscopic dacryocystorhinostomy operation. Continuation of complaints or a relative decrease in complaints were considered unsuccessful endoscopic dacryocystorhinostomy operation. Before surgery, informed consent was received from parents for all of the patients.

Surgical procedure

All of the patients were operated on under general anesthesia. The operations were performed by an ophthalmologist and otolaryngologist together with the patients in supine position and their heads elevated 30°. A 2.7 mm and 4 mm 0-degree rigid endoscopy were used in the operations.

To prevent nasal mucosal congestion, 4% Xylocaine and 1/30000 adrenaline embedded cotton pads were placed in the nasal passage (Figure 1a). After waiting 5 minutes, a 10 mm vertical and frontal cut was made 10 mm above the axillary process at the adherence point of the concha and in front of the uncinate process with a sickle knife (Figure 1b). Later, this cut was made 10 mm ovoid backward and it was elevated to the nasal flap posteriorly. Using a diamond-tipped drill, the part forming the frontal process of the maxillary bone and lacrimal bone was removed (Figure 1c). After the lacrimal sac could be seen clearly (Figure 1d), the medial wall was raised like a tent using the Bowman 00 probe from the lower punctum (Figure 1e).

An incision was made with a sickle knife, and then it was marsupialized. The edges of the lacrimal sac were dissected with forceps. After the bone osteoma was opened, it was trimmed with nasal mucosa forceps exceeding the lateral side of the lacrimal sac. After the upper and lower puncta were dilated, silicone tubes were run through the sac, the free ends were tied, and they were left in the nasal cavity (Figure 1f). In patients with nasal bleeding, a pad was placed in the nasal cavity following silicone tube intubation, which was removed the next day. The patients were prescribed saline spray four times a day to prevent crusting in the nasal cavity and 6x1 tobramycin + dexamethasone drops for the eye. Patient follow-ups occurred on post-operative Day 1 and then again in Weeks 1, 2, and 3, in Months 3, 6, and 12, and finally once a year.

Figure 1: (a) Adrenaline embedded cotton pads. (b) Mucosal incision. (c) Drilling of the frontal process of the maxilla. (d) Sac exposure. (e) Marsupialization of the sac. (f) Silicone tubes.

Results

EDCR was performed on 19 eyes of 17 patients in the study. Seven of the patients were female (41.2%) and the others were male (58.8%). The patients were between 1.7 years and 5 years old (mean = 3.3 years). Surgery was performed on the left eye in nine cases, on the right eye in six cases, and bilaterally in two cases. The general characteristics of the patients are shown in table 1. Follow-up periods for the patients were between 3 and 46 months (mean = 25.5 months). Surgical interventions on patients who received EDCR are shown in table 2.

Probing was performed three times on Patients 1, 8, 9, and 15, while it was performed twice on all other patients. Since the complaints of Patients 2, 3, 5, 7, 9, 12, 13, and 16 continued after the Month 3, silicone tube intubation was performed. Treatment was unsuccessful for two patients in this series. One of the patients had received end canalicular diode laser dacryocystorhinostomy

Patient number	Gender	Laterality	Age (years)	Follow up (months)	Success
1	Male	Right	4.8	42	Successful
2	Female	Right	3.7	38	Successful
3	Male	Left	5.0	46	Unsuccessful
4	Male	Left	3.2	3	Successful
5	Male	Right	2.8	22	Successful
6	Male	Right	1.8	18	Successful
7	Male	Right	1.7	16	Successful
8	Female	Left	2.4	15	Successful
9	Male	Left	2.8	13	Successful
10	Female	Left	3.5	19	Successful
11	Male	Bilateral	3.0	22	Successful
12	Male	Left	3.1	40	Successful
13	Female	Right	2.9	25	Successful
14	Female	Left	3.7	45	Successful
15	Female	Left	4.2	19	Unsuccessful
16	Male	Left	4.1	23	Successful
17	Female	Bilateral	3.4	28	Successful
3.3 25.5					

Table 1: General characteristics of the patients.

Patient Number	Probing Number	Other Surgical Processes
1	3 Probings	
2	2 Probings	Silicone tube intubation
3	2 Probings	Silicone tube intubation Endocanalicular diode laser
4	2 Probings	
5	2 Probings	Silicone tube intubation
6	2 Probings	
7	2 Probings	Silicone tube intubation
8	3 Probings	
9	3 Probings	Silicone tube intubation
10	2 Probings	
11	2 Probings	
12	2 Probings	Silicone tube intubation
13	2 Probings	Silicone tube intubation
14	2 Probings	
15	3 Probings	
16	2 Probings	Silicone tube intubation
17	2 Probings	

Table 2: Surgical interventions performed on the patients.

at another center. EDRS was performed 5 months later because the operation was unsuccessful. No significant complications were observed following EDRS. Nasal bleeding, which was stopped by a pad, was observed in two patients, valve edema was observed in one patient, and nasal scar formation was observed in one patient (whose operation was unsuccessful). No complications such as orbital cellulite, orbital fat herniation, or prolapsed silicone tube were observed.

Discussion and Conclusion

In this retrospective study evaluated the efficiency of EDCR in patients in early infancy who received failed surgical interventions such as silicone intubation and end canalicular diode laser dacryocystorhinostomy following recurrent probings. Our success rate was 89.4% in persistent pediatric epiphora cases. The rates of success in CNLDO treatment vary depending on the type of surgical intervention, patient's age, and the time of surgical intervention. It cannot be said that ophthalmologists have reached a certain consensus on the issue yet. Persistent CNLDO cases should be approached in stages, first with probing and irrigation in the first years of life, later with intubation or balloon dacryoplasty with probing irrigation, and lastly with dacryocystorhinostomy [13].

If probing interventions are unsuccessful, changes in the nasolacrimal duct anatomy seem to be responsible rather than a delay in the age of probing application. Unsuccessful probings are generally seen in the initial probing and are characterized by probing difficulty [14].

Kashkouli., *et al* [5]. had an 89% success rate for probing in the late childhood period of 13 - 24 months and 71.7% in the late childhood period of 25 - 60 months. Probing performed in late childhood has been considered a reason for failure. Arora., *et al* [6]. found that the success of probing decreased significantly after the age of 3 years, and that found the rate was 50%, while this rate was 78% after three years of age and as 72% in all patients.

Liegel and Lueder [15] had an 86% (30/35) success rate in 35 patients older than 4 years diagnosed with non-complicated membranous CNLDO. This result implies that performing this operation at a later age does not affect the success of probing.

Success decreases with repeated probings. In a study conducted by the Pediatric Eye Disease Investigator Group [16], the rate of success was found to be 56% for repeated probings. Gardiner., *et al*. [17], divided the patients who had an unsuccessful first probing into two groups and performed intubation in one group and a second probing in the other group. No difference was found between failure rates in the above-mentioned groups in which both silicone and secondary probing were applied.

In our study, as secondary therapy, we performed silicone intubation in three patients who had received two probings. Success decreases gradually after repeated probings. Forced probing application causes undesired scar formation and high stenosis formation in the nasolacrimal duct. In addition, occasional recurrent inflammations in the nasolacrimal duct can cause scar formation in these cases. Repeated probing can cause failure due to false tract formation [10,18]. Due to the above-mentioned reasons, unsuccessful intubation cases have been observed.

Hu., *et al* [19]. applied a balloon catheter and nasolacrimal duct intubation in children between the ages of 6 and 48 months with a history of failed probing. The overall success rate was 87.6% in the intubation group and 90.3% in the balloon group. For children younger than 24 months, the success rate was 89.7% in the intubation group and 91.9% in the balloon group; for children over 24 months, the success rate was 79.1% in intubation group and 84.0% in balloon group.

Pediatric end canalicular diode laser dacryocystorhinostomy (DCR) is a surgery which has recently become popular; however, its success rate has not been high. Nasal synechia and frequent granulomatous formation restrict the rate of success. Functional success of external DCR, EDCR, and laser DCR for nasolacrimal obstruction have been shown to have success rates of 81.8%, 72.4%, and 73.3%, respectively [20].

Among our cases, the only patient who had an unsuccessful operation had received endocanalicular diode laser DCR at another center. There are some difficulties in pediatric endonasal DCR, such as the anatomically narrow pediatric nasal airway, higher bleeding compared with adults, and greater lower concha when compared with the intranasal cavity. The development of otolaryngology endoscopic tools, clarification of lacrimal sac, the fact that agger nasi cells are not pneumatized, and the non-distinct structure frontal process of maxillary bone are advantageous for a safe and effective surgery [21-23].

In the pediatric age group, primary endoscopic endonasal dacryocystorhinostomy is a relatively recent application. Saniasiaya., *et al* [24]. conducted a literature review from the years 1995 to 2016 and found only 10 original clinical studies when they reviewed keywords such as epiphora, endoscopic dacryocystorhinostomy, laser assisted endoscopic dacryocystorhinostomy, and powered endoscopic dacryocystorhinostomy. When the existing studies were examined, the limited number of cases was remarkable [22,25]. Similarly, in his systematic review about EDCR results

in children, Gioacchini., *et al* [26] found that the number of patients in 14 studies differed between 6 and 71, and the mean ages were between 3.9 and 11.2.

Chan., *et al.* [23] published a multi-center pediatric EDCR study with 116 cases in 2017. This study was conducted between the years 2006 and 2011. These cases included 21 from Adelaide, Australia; 24 from Sydney, Australia; 23 from California, USA; 36 from Vancouver, Canada; and 12 from East Grinstead, United Kingdom. The average age of the patients was 5.9 years. The results showed that 75.9% (88/116) of the patients had received probing, 39.7% (46/116) had received silicone intubation, and a 90% success rate had been achieved. Due to the small sample groups and non-standardized procedures, it is difficult to present the factors which influence pediatric EDCR results. Studies conducted on patients with failed probing, silicone intubation, and DCR before pediatric endonasal EDCR are summarized in table 3.

When pediatric EDCR studies are examined, large case series are not seen because other surgical processes are successful prior to EDCR. Success in EDCR varies between 76% and 100%, as can be seen in table 3.

Study	Year	Number of Cases	Average Age (Years)	Number of Surgeries	Follow-Up Time (Months)	Number of Probings/ Number of Patients	Previous Surgery/ Number of Patients N	Rate of Success
Cunningham [22]	1998	4	3.5	4	18.2	6/4	ExtDCR/1	100%
Berlucchi [25]	2003	6	6	7	20	7/7	SI/7	100%
Jones [13]	2007	34	NI	43	21	*	SI/10	76%
Eloy [27]	2008	8	4.3	11	10.5	5/11	EDCR/1	N/A
Kominek [28]	2010	52	4.1	58	17	57/58	SI/NI	87. 9%
Celenk [21]	2013	71	8.9	83	27.1	NI	NI	92.7%
Saeed [18]	2014	50	6.2	55	12	**	NI	90.0%
Marfatia [29]	2017	19	4.5	21	6	NI	DCR/1	95.2%
Chan [23]	2017	103	5.9	116	8	88/116	SI 46/116 DCR/7	90.0%
Present study	2019	17	3.3	19	25.5	38/17	SI/8	89.4%

Table 3: Studies in which EDCR was conducted after probing and silicone intubation.

NI: no information. Ext DCR: External Dacryocystorhinostomy. SI: Silicone intubation.

*Once in 15 cases, twice in 7 cases, three times in 3 cases.

**Most cases had received probing twice, 10 cases had received probing three to four times.

Eloy., *et al.* [27] performed EDCR on a total of 11 eyes (primary EDCR on 10 eyes and revision on 1 eye) in eight patients. The average age of the patients was 4.3 years, while their average follow-up time was 10.5 months. Probing was performed on five patients in this series, while probing was not performed on patients with choanal atresia or microcephalia or those who had undergone DCR before. Three children had allergic rhinitis complaints. In this series, while viral rhinitis-dependent epiphora resulted in only one case, the other cases were successful. Probing was not performed on patients older than 1 year. Application of a routine silicone stent was not performed in this series. The Silicone stent application was performed only on revision DCR cases and lower canalicular stenosis cases.

Celenk., *et al.* [21] published a case series of 83 pediatric EDCR patients. While there was no information about the presence of probing or other surgical procedures before EDCR, only the patients who did not respond to conservative treatment and those who had trauma, punctal agenesis, and punctal stenosis were included. This study, conducted in an otorhinolaryngology clinic, was performed as primary surgery rather than EDCR on treatment-resistant cases. In this series, the average age of the patients was 8.9 years, and the success rate was 92.7%. Saeed and Tawalbeh [18] published a retrospective case series of 50 patients. In this series, the average age was 6.2 years. The patients in this group received at least one probing, while 10 patients received three or four probings. However, children younger than 3 years were not operated on in this study.

In our study, we considered the resolution of symptoms with irrigation as recovery. We considered patients with allergic rhinitis and wind-induced symptoms as unsuccessful, even with anatomic success. Our success rate was 89.4% for these cases.

There is no consensus among researchers regarding silicone stents. While a silicone stent has been considered necessary for success in some studies [25], it has disadvantage in other studies [23]. Since all of our patients had received multiple surgical interventions, we performed post-EDCR silicone intubation. While the most frequent endoscopic findings in unsuccessful DCRs are nasal fibrosis and synechia, the most frequent reasons for failure are the large size and unsuitable location of bone osteoma as well as fibrosis at rhinotomy [30]. In addition, in children with a high incidence of upper respiratory tract infection, there is a risk for obstruction of newly opened osteoma [18].

Our two unsuccessful patients had nasal synechia; however, this was not completely blocking the bone ostium. One of the unsuccessful patients had undergone endoscopic diode laser DCR, and he was receiving allergic rhinitis therapy. For this patient, watering occurred occasionally. In this study, our purpose was to contribute to the literature by proving that even in young children who received unsuccessful surgical interventions, EDCR can be performed safely.

Although pediatric EDCR has difficulties, such as working in a narrow area, difficulty with manipulation, higher levels of bleeding when compared with adults, and use of special pediatric nasal equipment, it should be the preferred method in patients who do not respond to conservative treatment or other surgery or who have lacrimal system obstructions in addition to nasal pathologies. Despite multiple surgical processes, EDCR can be safely applied in patients with persistent epiphora with a high rate of success. Due to its advantages, such as not causing any scars on the skin, a short hospitalization period, and not disrupting tear pumping functions, this surgery has begun to be preferred in patients with persistent epiphora in early childhood.

Disclosure Statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Funding

There is no funding for our research.

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