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Factors Related to Success in Endoscopic Dacryocystorhinostomy (Success Factors in Endoscopic Dacryocystorhinostomy)

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ABSTRACT

Objective: Endoscopic dacryocystorhinostomy (EDCR) is a widely accepted surgical technique for the management of nasolacrimal duct obstruction. Various factors may influence the success of this procedure; therefore, identifying these determinants is crucial for optimizing surgical outcomes. The aim of the present study was to investigate factors potentially affecting the success of EDCR.

Methods: A total of 287 sides from 261 adult patients diagnosed with chronic dacryocystitis who underwent EDCR were included in the study. Surgical success was defined as the absence of epiphora based on history and physical examination, confirmation of patent lacrimal system through irrigation, and presence of patent rhinostomy as determined by endoscopic examination. The impact of factors including sex, age, the type of anesthesia (general or local), preservation of nasal mucosal flap (with or without flap), surgical instrument used [mechanical (rongeur and chisel), powered (microdebrider)], presence of pus, and stent placement (with or without stenting) on surgical success was investigated based on the patients' medical records.

Results: Out of the cases, 259 were successful, resulting in a success rate of 90.2%. Univariate analysis identified 3 variables with the potential to affect success. These variables were sex, surgical instrument used, and stent placement. Through multivariate analysis, the use of surgical instruments and stenting were identified as factors influencing success. The use of powered instruments and stent placement were found to be factors that increase success (odds ratios 3.621 and 5.316, respectively).

Conclusion: The use of powered instruments and stent placement emerged as factors that increase success in this study.

Keywords: Dacryocystorhinostomy, endoscopy, epiphora, stents, surgical instruments, treatment outcome

Introduction

Dacryocystorhinostomy (DCR) is a surgical procedure used for the resolution of nasolacrimal duct obstructions by creating an alternate passage between the lacrimal sac and the lateral nasal wall. The procedure has traditionally been performed externally, and after the introduction of endoscopic systems, endoscopic dacryocystorhinostomy (EDCR) surgery was described. The reported success rates of external DCR vary between 90% and 95%.[1] Endoscopic dacryocystorhinostomy success rates, which were low at the beginning as a natural result of the advent of the endoscopic technique later on, are comparable to those achieved with the external methods today. The absence of external scarring, intact pump function, lower risk of bleeding, and rapid postoperative recovery made the EDCR procedure a more preferable alternative.[3]

The focus of the literature has shifted from comparing external and EDCR to identifying factors that improve the success of EDCR.[4-7] The success rates of EDCR vary from 85% to 99%.[8] Although success rates are high for this relatively new procedure, there are still large differences in success rates across studies. Such variations may be related to a number of factors such as differences in patient inclusion criteria, instruments used, surgical technique, or stenting. It is possible to determine the factors affecting success more clearly with further

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research and efforts in that direction. The study was designed as a continuation of these efforts and sought to investigate the factors that can potentially affect success in EDCR.

Methods

Adult patients diagnosed with chronic dacryocystitis who underwent EDCR between March 2019 and March 2022 were included in the study. This retrospective study was approved by the Clinical Research Ethics Committee of University of Health Sciences Tepecik Training and Research Hospital Non-Interventional Research Ethics Committee (Approval No. 2022/04-27, Approval date: April 15, 2022). Because of the retrospective nature of the study, the requirement for written informed consent was waived by the Ethics Committee. The diagnosis was made by the otolaryngologists in consultation with ophthalmologists based on irrigation and probing of the nasolacrimal system in patients with complaints of epiphora for more than 1 year. Endoscopic evaluation of the nasal cavity was performed in all patients as part of the preoperative evaluation. Computed tomography imaging was included in the routine examination to rule out additional nasal/paranasal sinus pathologies. Patients 18 years of age or older, of both sexes, were included in the study. Patients with proximal (punctal or canalicular) obstruction, suspected functional nasolacrimal duct obstruction, previous history of lacrimal surgery, suspected malignancy, radiotherapy to the head and neck region, patients who were lost to follow-up postoperatively, and those with intellectual disability were excluded from the study.

Surgery was performed under local or general anesthesia. Decongestion and topical anesthesia of the nasal cavity were achieved using pads soaked with 1% lidocaine and epinephrine (1 : 100 000) solution. This solution was injected into the surgical site. A 0° or 30° nasal endoscope with a diameter of 4 mm was used throughout the procedure. With a scalpel, a vertical incision connecting the 2 horizontal incisions was used to create a nasal mucoperiosteal flap posteriorly. An upper horizontal incision was performed starting approximately 8-10 mm above the axilla of the middle turbinate and extending approximately 10 mm anteriorly. Then, a vertical incision was made, extending from the anterior border of the superior horizontal incision to half the vertical length of the middle turbinate. Flap incision was completed by joining the inferior horizontal incision starting from the insertion of the uncinate process with the lower border of the vertical incision. The osteotomy area was exposed by lifting the mucoperiosteal flap using a Freer elevator. Osteotomy was initiated with the aim to create a bony opening with a diameter of at least 10 mm. Mechanical (chisel and rongeur) or powered (microdebrider) instruments were preferred for osteotomy. Osteotomy performed with mechanical instruments was started using a Cottel curved chisel. The chisel was positioned parallel to and approximately 3 mm anteriorly to the junction of the lacrimal bone and frontal process, and a fracture was created in the bone. The bone overlying the lacrimal fossa was removed, taking care to avoid damage to the lacrimal sac mucosa. A 45° Kerrison rongeur was used for the bone superior to the axilla of the middle turbinate, which is thicker and more difficult to remove. In cases where a microdebrider was used, an angled (15°) 4 mm bur attached to the microdebrider (Medtronic Xomed, Jacksonville, FL, USA) was used to elevate the frontal process and the lacrimal bone. After completion of the osteotomy procedures, the nasolacrimal duct, the body of the sac, and the fundus of the sac were exposed. The puncta of the upper and lower canaliculi were dilated using a small dilator. Patency of the nasolacrimal system (punctal and canalicular) was checked using a lacrimal probe. A vertical incision was made starting from the top to the bottom of the lacrimal sac using a sickle knife. At that time, if there was pus coming from the sac, it was aspirated. A "C" shaped lacrimal sac flap was created by making 2 horizontal incisions using microscissors at the upper and lower points of the vertical incision posteriorly. By rolling the flap backwards, the continuity of the lacrimal sac and nasal mucosa was ensured. Silicone stents with a diameter of 0.6 mm (Beaver-Visitec, Warwickshire, UK) were passed through the upper and lower puncta and removed from the rhinostomy area. The ends of the tubes were connected to each other in the middle meatus. In cases where the nasal mucosal flap was preserved, the flap covering the rhinostomy area was trimmed. Strip-shaped upper and lower nasal mucosal flaps were laid on the free bony margins of the rhinostomy site. At the end of the procedure, a gel foam was placed over the flap to hold the flaps in place. A small nasal packing was placed at the surgical site to be removed 1 day later.

All patients were given eye drops containing a combination of steroids and antibiotics in addition to systemic antibiotics for 5-7 days. The patients were instructed to perform nasal irrigation for 4 weeks. Postoperative follow-up visits occurred at 1 day and 1, 3, 6, and 12 weeks. For patients with stent placement, the stents were removed at 6-12 weeks postoperatively. Patency of the nasolacrimal system was assessed 4 weeks after removal of the stents. Subsequently, the patients were followed every 3 months until they remained asymptomatic for 12 months.

Surgical success was defined as the absence of epiphora confirmed by history and physical examination, observation of patency of the lacrimal system by irrigation, and the presence of patent rhinostomy through endoscopic examination. The effects of several factors retrieved from the medical records of the patients including sex, age, the type of anesthesia (general or local), preservation of the nasal mucosal flap (with or without flap), surgical instrument used (mechanical [rongeur and chisel], powered [microdebrider]), the presence of pus, and stent placement (with or without stent) on surgical success were investigated.

Main Points

- Powered instrument use and silicone stent placement were identified as independent factors significantly increasing the success rate of endoscopic dacryocystorhinostomy.
- Patient-related and perioperative variables, including age, sex, anesthesia type, flap preservation, and the presence of pus, showed no significant effect on surgical success.
- Optimizing surgical technique—particularly adequate bone removal using powered instruments and maintaining ostium patency with stenting—appears to be more critical than demographic or perioperative factors in achieving successful endoscopic dacryocystorhinostomy outcomes.

Statistical Analysis

The study data were analyzed using the Statistical Package for the Social Science (SPSS) Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, NY) software. Descriptive statistics are summarized as number (n), percentage (%), and mean ± standard deviation ($\bar{x}$ ± SD). The variables with a *P* value of less than .25 in univariate analyses were included in binary logistic regression analysis to determine the factors affecting surgical success. The backward elimination (Wald) method was used to establish the final variables associated with success. A *P* value less than .05 was considered statistically significant.

Results

A total of 261 patients with a mean age of 47.9 years were included in the study. Bilateral EDCR was performed in 26 patients. In total, 287 sides were included in the analyses. Endoscopic dacryocystorhinostomy was successful in 259 patients, resulting in a success rate of 90.2%. Among the patients, 226 (78.7%) were female and 61 (21.3%) were male. One hundred sixteen surgeries were performed under general anesthesia and 171 under local anesthesia. Flap was preserved in 196 cases and not preserved in 91 cases. While 211 surgeries were performed with mechanical instruments, powered instruments were used in 76 cases. The number of patients with or without pus was 185 and 102, respectively. There were 277 cases with stent placement and 10 cases without.

Univariate logistic regression analysis of the factors including sex, type of anesthesia, whether or not the flap was preserved, instrument used, the presence of pus, and stent placement revealed 3 variables that potentially affect surgical success. These variables were sex, instrument used and stenting (*P* values .163, .059, .042) (Table 1).

Multivariate logistic regression analysis showed that the instrument used and stenting are the factors affecting surgical success. Powered instrument use and stent placement were identified as factors that are more likely to increase EDCR success (odds ratio [OR] 3.621, 95% CI 1.035-12.665; 5.316, 95% CI 1.216-23.235, respectively) (Table 2).

Discussion

Investigation of factors related to EDCR success revealed that patient sex, age, anesthesia type, nasal mucosal flap preservation, and presence of pus do not significantly affect outcomes. Powered instrument use and stent placement were the main factors associated with improved surgical success.

Mixed results have been reported in studies examining the impact of age and sex on EDCR success. In a study by Jung et al[5]evaluating 1083 EDCR procedures, sex and age were not related to surgical failure. Nomura et al[4] stated that advanced age was associated with poor surgical outcomes, and they attributed this finding to decreased orbicularis muscle function with age, which has a negative effect on lacrimal pump function. In contrast, Keren et al[6] reported that age and sex were not factors affecting the risk of surgical failure. Cohen et al[9] found that advanced age and male sex were associated with long-term EDCR failure. In the study, it was observed that sex and age were not likely to affect surgical success.

Theoretically, the type of anesthesia used in EDCR may affect success through surgeon comfort, patient comfort, or intraoperative variables. In a study comparing the type of anesthesia chosen (local versus general) in young patients undergoing external DCR, local anesthesia was found to be comfortable and safe.[10] In a study by Choi et al analyzing the tolerability and success of EDCR surgery, when asked whether they would prefer local anesthesia, 82% of the patients said they would opt for local anesthesia again if their other eye needed to be operated on.[11] In that study, the subjective success rate was over 90%.[11] In light of the aforementioned results, it can be argued that the type of anesthesia chosen in EDCR is not related to success and does not affect success rates through patient and

Table 1. Univariate Binary Logistic Regression Analysis of Factors

							95% CI for *Exp (β)*	
		B	S.E.	Wald Statistics	*P*	Odds Ratio	Lower	Upper
Sex	Female	Reference	0.629	1.946	.163	2.405	0.701	8.249
	Male	0.877						
Age		−0.007	0.014	0.275	.6	0.993	0.965	1.021
Anesthesia	General	Reference	0.402	0.077	.782	1.118	0.508	2.460
	Local	0.111						
Flap	With	Reference	0.456	0.639	.424	1.440	0.589	3.521
	Without	0.365						
Instrument	Mechanical	Reference	0.626	3.578	.059	3.271	0.958	11.165
	Powered	1.185						
Pus	Without	Reference	0.425	0.156	.693	1.183	0.514	2.720
	With	0.168						
Stent	Without	Reference	0.721	4.116	.042	4.320	1.051	17.758
	With	1.463						

Table 2. Multivariate Binary Logistic Regression Analysis of Factors

							95% CI for *Exp* (β)	
		β	S.E.	Wald Statistics	*P*	Odds Ratio	Lower	Upper
Constant		0.417	0.735	0.322	.571	1.517		
Instrument	Mechanical	Reference	0.639	4.058	.044	3.621	1.035	12.665
	Powered	1.287						
Stent	Without	Reference	0.752	4.930	.026	5.316	1.216	23.235
	With	1.671						

Variable(s) entered at step 2: instrument, tube. Elimination method: Backward Wald, Hosmer and Lemeshow test.
$\chi 2 = 0.184$.
$P = .668$.
Nagelkerke $R^2 = 0.063$.

surgeon comfort. Similarly, in the study, the type of anesthesia did not have any effect on success rates.

Preservation of nasal mucosal flap in EDCR is believed to reduce the likelihood of formation of granulation, crusting, and synechia.[12,13] In a systematic review examining the impact of nasal mucosal and lacrimal flaps on surgical outcomes in EDCR, a trend toward reduced granulation and improved outcomes was observed with preservation of the flaps.[12] However, the authors of that study suggested that further good-quality research is warranted due to insufficient evidence for this trend.[12] In 1 study randomly assigning patients to 2 groups (preserved versus non-preserved flap), it was reported that nasal mucosal flap reduced granulation and scar formation by covering the exposed bone.[14] In that study, a lower risk of ostium closure and a higher success rate of EDCR were observed in the group with flap preservation.[14] In a study by Kansu et al[14] examining long-term outcomes of EDCR, preservation of nasal mucosal flap was found to reduce granulation tissue formation but had no effect on surgical success rates. In a separate study, no difference was observed between the groups with or without flap preservation in terms of success rates.[16] Consistently, in the current study, preservation of nasal mucosal flap showed no effect on EDCR success. According to the observations and experience, a greater match between the flap removal area and the ostium area (in terms of size, shape, and width) will result in less granulation formation. If the flap design is good, the exposed bone tissue will be at an acceptable level, and in this case, flap preservation will not be a relevant factor for success.

Creating a wide bony window is 1 of the key determinants of success in DCR.[17] The upper half of the lacrimal sac may extend 1 cm above the axilla of the middle turbinate, and removal of the thick bone located in this area is the most important component of creating an appropriate bony window of adequate size. In a study using a diamond bur to remove the bone above the axilla of the turbinate, Wormald and Tsirbas[16] presented a new technique which they referred to as "powered EDCR" and reported an overall success rate of 95% and results as good as those obtained with the traditional external DCR. Beshay and Ghabrial[17] reported high success rates using a non-powered technique involving the use of rongeurs in a study evaluating long-term outcomes of EDCR surgery. In a systematic review and meta-analysis examining the impact of surgical technique on EDCR, no significant difference was observed between the success rates achieved with the mechanical or powered technique.[7] However, when the studies included in that review were further analyzed, it was determined that a bur was also used during the surgery in some studies reporting the use of mechanical instruments. In this study where mechanical or powered instruments were used, the use of a powered instrument was identified as a factor associated with greater surgical success. Using a powered instrument to remove the thick bone superior to the surgical site is an important choice that increases success.

No previous study has evaluated whether the presence of intraoperative pus within the lacrimal sac during DCR affects surgical success, although several studies have investigated the effectiveness of DCR procedures in the treatment of acute dacryocystitis and lacrimal abscess.[19,20] In the present study, the presence of intraoperative pus had no significant effect on surgical success.

There are published studies in the current literature arguing that stent placement is not necessary for resolving obstructions of the distal nasolacrimal system.[21-23] In a study excluding presaccal stenoses, it was concluded that there was not a statistically significant advantage of stenting in EDCR.[21] Likewise, in 2 different studies involving postsaccal stenoses, it was reported that surgical success can be achieved without using a stent and that stenting is unnecessary.[22,23] Studies endorsing the viewpoint that stenting is unnecessary point out the fact that stent placement is associated with granulation formation, increased risk of infection, canalicular laceration, and reduced patient comfort. In a meta-analysis including studies on distal stenoses, no difference was observed between silicone stent and control groups with respect to success and morbidity rates.[24] However, in the same study, further meta-analyses showed that there was a trend for improved success rates with the use of mucosal flap in combination with stent insertion and a trend for reduced morbidities such as granulation and synechia.[24] In this study, stent placement was found to be a factor likely to increase surgical success. Based on the experience, the advantages of stenting outweigh its disadvantages in distal nasolacrimal system obstructions. Stent placement facilitates the contact of lacrimal flap and nasal mucosa and reduces the risk of restenosis in cases where the medial wall of the lacrimal sac is preserved. As such, stenting in EDCR or at least a lower decision-making threshold for doing so may be a factor that could positively affect success.

The lack of subgroup analyses according to sex (male vs. female), as well as the absence of separate analyses based on follow-up intervals to compare early and late postoperative ostium patency, could be acknowledged as potential limitations. Incorporating a large patient series and providing the first examination of how anesthesia type affects EDCR success, the study possesses significant methodological strengths.

Powered instrument use and stent placement were identified as the main factors associated with improved surgical success. Further studies involving the pediatric age group and patients with proximal stenosis will make a valuable contribution to the literature.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: The authors declared that no artificial intelligence tool was used in the preparation of the manuscript.

Ethics Committee Approval: Ethical committee approval was received from the University of Health Sciences Tepecik Training and Research Hospital Non-Interventional Research Ethics Committee (Approval no: 2022/04-27, Date: April 15, 2022).

Informed Consent: Because of the retrospective nature of the study, the requirement for written informed consent was waived by the Ethics Committee.

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