Factors Affecting the Success of External Dacryocystorhinostomy for the Treatment of Nasolacrimal Duct Obstruction.

Achara Chaiwiriya

Department of Ophthalmology, Maharaj Nakhon Si Thammarat Hospital, Thailand

Abstract

Purpose: To investigate the factors influencing the success of external dacryocystorhinostomy (DCR) surgery in patients with nasolacrimal duct obstruction.

Study Design: Retrospective cohort study.

Methods: Data were retrospectively collected from patients who underwent external dacryocystorhinostomy at Maharaj Nakhon Si Thammarat Hospital and Fort Wachirawut Hospital between January 1, 2021, and December 31, 2023. Patients were followed up for at least 6 months postoperatively. Surgical failure was defined as cases where lacrimal irrigation could not pass into the throat.

Results: A total of 112 patients were included in the study, with an average age of 70.10 years in the successful group and 60.50 years in the unsuccessful group. The success rate of the surgery was 92.86%. Factors significantly associated with surgical success included patient age, which had a positive correlation with surgical success (OR 1.1186; 95%CI: 1.025-1.221, P = 0.012), while the presence of glaucoma was negatively associated with successful outcomes (OR 0.0317; 95%CI: 0.002 - 0.548, P = 0.018).

Conclusions: Factors associated with the success of external DCR surgery for nasolacrimal duct obstruction include patient age and the presence of glaucoma. Careful patient selection and well-planned treatment strategies are crucial for increasing the likelihood of surgical success.

Keywords: Nasolacrimal duct obstruction, External dacryocystorhinostomy, Surgical success factors, Glaucoma

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Introduction

Obstruction of the lacrimal drainage system can occur at various points. It is categorized into the proximal section, including the punctum, canaliculus, common canaliculus, and the distal section involving the lacrimal sac and nasolacrimal duct.

Punctual and canalicular obstruction can result from factors such as medications (e.g., pilocarpine, epinephrine, phospholine iodide, and idoxuridine), trauma, radiation therapy, chronic inflammation due to infections like *Actinomyces israelii*, autoimmune diseases such as ocular cicatricial pemphigoid and Stevens-Johnson syndrome. Nasolacrimal duct obstruction (NLDO) is often caused by involutional stenosis associated with aging, trauma, prior surgeries, radiation therapy, chronic sinus disease, dacryocystitis, and tumors.[1,2]

Nasolacrimal duct obstruction (NLDO) has a relatively high incidence rate of 20.24 per 100,000 population, indicating that it is a relatively common condition.[3,4] NLDO can occur from newborns to the elderly and is more common in females than males. The condition typically presents with symptoms of excessive tearing (*epiphora*) and inflammation of the lacrimal sac (*dacryocystitis*).[5,6] NLDO results from impaired tear drainage causing the buildup of tears and debris within the lacrimal sac, providing an ideal environment for infections

Correspondence to:
Achara Chaiwiriya, *Department of Ophthalmology, Maharaj Nakhon Si Thammarat Hospital, Thailand. E-mail: achara_pun@hotmail.com*
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and inflammation. Left untreated, *dacryocystitis* may progress to severe complications that pose a threat to vision or life-threatening conditions.[7]

External Dacryocystorhinostomy is a commonly employed surgical approach for treating nasolacrimal duct obstruction. Although Endonasal Dacryocystorhinostomy has gained popularity over the past decade, many surgeons still prefer External Dacryocystorhinostomy due to its higher reported success rates.[8-10] A comparison between external and endonasal dacryocystorhinostomy (DCR) techniques reveals important clinical and surgical distinctions that justify the continued focus on external DCR, particularly in primary acquired nasolacrimal duct obstruction. External DCR provides direct visualization of the lacrimal sac and adjacent structures, allowing precise surgical manipulation, greater control of intraoperative bleeding, and facilitating more controlled osteotomy and mucosal flap formation, both of which are essential for durable outcomes. Although endonasal DCR offers the advantage of being less invasive with no visible scarring, its success rates are slightly lower or comparable to external DCR.[11-22] For instance, Nailwal et al.[23] reported a 93.3% success rate for external DCR versus 90% for endonasal DCR, while Dasgupta et al.[24] showed 94.54% and 91.07%, respectively. Salih et al.[25] further confirmed superior outcomes for external DCR, with an 85% success rate with silicone intubation compared to 77.5% for endoscopic DCR. Moreover, Lee et al.[8] demonstrated an anatomical success rate of 98.8% in a large cohort of 769 patients undergoing external DCR. These data underscore the reliability and adaptability of external DCR, supporting its continued role as the gold standard procedure in the surgical management of nasolacrimal duct obstruction.

However, the outcomes of External Dacryocystorhinostomy are influenced by various factors. Therefore, this study aims to investigate and analyze these factors to enhance the effectiveness and success rates of the treatment and minimize potential complications associated with the procedure.

Materials and Methods

This study was approved by the Ethics Committee for Research of Maharaj Nakhon Si Thammarat Hospital. It was designed as a retrospective cohort study, collecting data from the medical records of patients who underwent External Dacryocystorhinostomy for nasolacrimal duct obstruction. All procedures were performed by the same ophthalmologist at Maharaj Nakhon Si Thammarat Hospital and Fort Wachirawut Hospital between January 1, 2021, and December 31, 2023. Patients with secondary NLDO who had a history of ocular adnexal tumors, failed DCR, acute dacryocystitis, traumatic NLDO, previous nasal cavity surgery and patients with events or diseases that can affect the lacrimal drainage system such as facial nerve palsy or lower lid ectropion were excluded. Several variables were analyzed in this research, including age, gender, duration of nasolacrimal duct obstruction, presence of inflammatory abscess of the lacrimal sac (dacryocystitis), affected side, history of glaucoma, history of cataract surgery, other medical conditions, complications, and results of lacrimal irrigation post-surgery.

Surgical Procedure

Patients with acute dacryocystitis received treatment to resolve the infection before surgery. The procedure was performed under local anesthesia using 1% xylocaine combined with adrenaline 1:100,000 using a 25-gauge needle. The anesthetic was injected at three specific sites: the medial wall of the orbit above the medial canthal tendon, approximately 1 centimeter below the orbital rim, and at the planned incision site. After that, a topical anesthetic spray was applied inside the nasal cavity followed by the insertion of gauze soaked in 1 ampoule of adrenaline.

Surgical Steps

A skin incision was made using a No. 15 surgical blade on the medial side of the inner canthus, approximately 1 centimeter from the medial canthal area, with a length of 1-1.5 centimeters. The subcutaneous layer was dissected until the periosteum overlying the frontal process of the maxillary bone was exposed. The periosteum was incised with a No. 15 surgical blade and dissected along the anterior lacrimal crest into the lacrimal sac fossa, extending to the maxillary-lacrimal suture. Then, a Freer elevator was used to separate the bone while carefully avoiding damage to

the nasal mucosa. A Kerrison rongeur was employed to remove the bone at the lacrimal fossa, creating an opening approximately 1 to 1.5 cm in size. The nasal mucosa was incised with a crescent knife. The upper and lower puncta were dilated using a punctal dilator, and a lacrimal probe was inserted through both the upper and lower puncta, extending into the lacrimal sac. The lacrimal sac was opened using a crescent knife. Crawford-style, bicanalicular, silicone stents were inserted through the upper and lower puncta, passed through the surgically created opening, and into the nasal cavity. The ends of the silicone stents were tied together, leaving the knot within the nasal cavity, and the excess silicone was trimmed. The nasal mucosa and lacrimal sac were sutured with 6-0 vicryl, and the skin incision was closed in two layers using 6-0 vicryl and 6-0 nylon sutures.

Post Operation

Postoperative care involved prescribing Augmentin 1 gram (amoxicillin 875 mg and clavulanic acid 125 mg) to be taken twice daily, 2 grams per day for 7 days. Antibiotic-steroid eye drops and nasal steroid sprays were administered twice daily for 1 month. During the first postoperative week, patients were advised to avoid forceful nose-blowing and nose-picking. Sutures were removed 7 days after surgery. Follow-up appointments were scheduled at 1 week, 1 month, 3 months, and 6 months postoperatively, ensuring a minimum follow-up duration of 6 months. Silicone stents were removed after 3 months, either in the eye clinic or the ENT clinic if nasal endoscopy was required to locate the stents. Removal involved cutting the stents near the medial canthus with scissors and pulling them out through the nasal cavity. The lacrimal ducts were then irrigated to assess the success of the treatment.

Definitions

Anatomical success: Defined as good passage without significant reflux on the lacrimal syringing test and fluid passage into the nasal cavity.

Acute dacryocystitis: Severe inflammation or infection of the lacrimal sac characterized by redness and pain occurring less than 2 weeks before the hospital visit.

Chronic dacryocystitis: Mild inflammation or infection of the lacrimal sac occurring continuously or intermittently for more than 2 weeks before the hospital visit.

Data Analysis

Statistical analysis was performed using SPSS® IBM (Statistics version 21) by Oracle Corporation, USA. Baseline characteristics of the sample group were compared between those with successful and unsuccessful treatment outcomes using the independent t-test for continuous variables and the Chi-square test for categorical variables. A two-step process was employed to analyze factors affecting treatment success, step 1 starting with univariable regression analysis to identify variables with a P value < 0.1, step 2 followed by multivariable regression analysis with the significance level set at 0.05.

Study Results

From January 1, 2021, to December 31, 2023, 121 cases of nasolacrimal duct obstruction were treated using the External Dacryocystorhinostomy method. Of these, nine patients were excluded from the study due to incomplete follow-up within six months, leaving 112 patients. Among them, 104 cases were successful (92.86%), while 8 cases failed (7.14%). The study analyzed data from the surgeries without including repeat surgeries. The patients' ages ranged from 33 to 89 years, with a mean age of 70.10 years in the successful group and 60.50 years in the unsuccessful group. Statistical analysis revealed a significant age difference between the two groups (P = 0.031). In the successful group, there were 100 females and 4 males, at a ratio of 25:1, compared to 5 females and 3 males in the unsuccessful group. In terms of the affected eye, the successful group included 53 cases of right-eye obstruction and 51 cases of left-eye obstruction. The unsuccessful group had 2 cases of right-eye obstruction and 6 cases of left-eye obstruction. The average duration of symptoms in the successful group was 19.83 months, with a standard deviation (SD) of 25.56 months, compared to 10.50 months with an SD of 3.12 months in the unsuccessful group. A history of dacryocystitis was present in 66 cases in the successful group and 8 cases in the unsuccessful group (P = 0.086). Postoperative complications occurred in 8 patients in the successful group and

1 patient in the unsuccessful group, all involving postoperative bleeding managed with anterior nasal packing, which effectively stopped the bleeding in all cases. Among patients diagnosed with glaucoma, 9 cases were in the successful group, while 3 were in the unsuccessful group, with a statistically significant difference (P = 0.041). Regarding cataract surgery history, 16 patients in the successful group and 2 in the unsuccessful group had undergone the procedure (P = 0.830). The successful group had 46 patients with comorbidities, while the unsuccessful group had only 1 patient.

However, no statistically significant difference was found regarding the presence of comorbidities between the two groups (P = 0.167), as shown in Table 1.

Table 1: Comparison of patients' characteristics between the successful and unsuccessful groups.

Variable	Success Group (n = 104)	Unsuccessful Group (n = 8)	P value[a]
Age (mean ± SD; years)	70.10 ± 11.48	60.50 ± 17.44	0.031
Gender (F:M)	100 : 4	5 : 3	0.0024
Laterality (Rt:Lt)	53 : 51	2 : 6	0.098
Duration of symptoms (mean ± SD; months)	19.83 ± 25.56	10.50 ± 3.12	0.306
Previous dacryocystitis, n (%)	Present 66 (89.19) Absent 38 (100)	Present 8 (10.81) Absent 0 (0.0)	0.086
Complication, n (%)	Present 8 (88.89) Absent 96 (93.2)	Present 1 (11.11) Absent 7 (6.8)	0.810
Glaucoma, n (%)	Present 9 (75.0) Absent 95 (95.0)	Present 3 (25.0) Absent 5 (5.0)	0.041
Previous cataract surgery, n (%)	Present 16 (88.89) Absent 88 (93.62)	Present 2 (11.11) Absent 6 (6.38)	0.830
Systemic diseases, n (%)	Present 46 (97.87) Absent 58 (89.23)	Present 1 (2.13) Absent 7 (10.77)	0.167

[a]Student t-test or Chi-square test

Univariable analysis revealed statistically significant factors associated with surgical failure. Age factor showed a positive correlation with surgical success, with an odds ratio (OR) of 1.0583 for each additional year, indicating an increased likelihood of success with age (P value = 0.060). Female patients had significantly higher odds of surgical success compared to male patients (OR = 16.6875, P value = 0.002), indicating that gender also plays a critical role in surgical outcomes. Conversely, the presence of glaucoma was significantly negatively associated with surgical success (OR = 0.1255, P value = 0.014), suggesting that glaucoma reduces the likelihood of a successful outcome.

Multivariable regression analysis indicated that age remained a statistically significant factor influencing surgical success. For each additional year of age, the odds of a successful surgery increased (OR = 1.1186, P value = 0.012). Glaucoma was identified as a significant risk factor negatively impacting surgical success (OR = 0.0317, P value = 0.018), demonstrating a significant reduction in the likelihood of success for patients with glaucoma. However, gender was not significantly associated with surgical success in the multivariable analysis as shown in Table 2. Details of the failed cases are shown in Table 3.

Table 2: Factors affecting the success of surgery for nasolacrimal duct obstruction when analyzed using univariable analysis and multivariable regression analysis.

Variable	Odds ratio (95%CI)	P value*
univariate		
Age	1.0583 (0.998-1.123)	0.060
Gender	16.6875 (2.755-101.076)	0.002
Laterality	0.8834 (0.330-2.366)	0.805
Duration of symptom	1.0500 (0.954-1.156)	0.320
Previous dacryocystitis	0.4561(0.056-2.643)	0.435
Complication	0.4884 (0.051-4.647)	0.533
Glaucoma	0.1255 (0.024-0.662)	0.014
Previous cataract surgery	0.4430 (0.078-2.513)	0.358
Systemic diseases	4.3333 (0.501-37.451)	0.185
multivariate		
Age	1.1186 (1.025-1.221)	0.012
Gender	6.6747 (0.729-61.124)	0.093
Glaucoma	0.0317 (0.002-0.548)	0.018

*Statistical significance at $P < 0.05$

Table 3: Failed case characteristics

Case	Age/ sex/ laterality	Duration of symptom	Cause of failure
1	33/F/L	7 mos CDC	inadequate lacrimal sac marsupialization
2	55/M/L	9 mos CDC, POAG	CCO c lacrimal sac fibrosis
3	60/F/L	10 mos CDC	CCO c lacrimal sac fibrosis
4	45/M/R	9 mos CDC, POAG	CCO c lacrimal sac fibrosis
5	52/F/L	12 mos CDC	Post-op bleeding, cicatricial closure of ostium
6	65/F/L	10 mos CDC, DM2	Cicatricial closure of ostium
7	58/M/R	8 mos CDC, POAG	Cicatricial closure of ostium
8	38/F/L	6 mos CDC	Small osteotomy

CDC, chronic dacryocystitis; POAG, primary open angle glaucoma; DM2, type 2 diabetes mellitus; CCO, common canalicular obstruction.

Discussion

This study has found that several factors influence the success of External Dacryocystorhinostomy (DCR) surgery for treating nasolacrimal duct obstruction. The success rate was 92.86%, which is consistent with previous studies reporting success rates of approximately 90%.[8-10] However, direct comparisons between studies remain limited due to variations in surgical techniques, follow-up durations, and definitions of success used in different research contexts. Despite these limitations, the findings highlight certain factors significantly impacting surgical outcomes. The common causes of a DCR failure are cicatricial closure of the ostium, inadequately sized osteotomy, inadequate lacrimal sac marsupialization, common canalicular obstruction, intervening ethmoids, inappropriately placed osteotomy with respect to the lacrimal sac leading to sump syndrome, turbinoseptal synechiae in and around the ostium, inappropriate granulation tissue, and internal ostium stenosis.[26-29] This is similar to the present study; however, due to the small number of cases, the analysis did not reach statistical significance.

Patient age came out as a significant factor influencing the success of External DCR. Older patients demonstrated a higher likelihood of successful surgery, particularly those with an average age of 70.10 years, who exhibited significantly higher success rates compared to younger patients (P = 0.012). This aligns with the findings of Erdol et al.,[9] which reported lower surgical success rates in younger patients compared to older ones. This factor may be attributed to anatomical and physiological changes associated with aging, potentially reducing the complexity of the surgical procedure. However, Nomura et al.[30] indicate slightly lower success rates in older patients (≥ 65 years) compared to younger patients. Future research should investigate whether failures in younger patients are attributable to specific technical, anatomical, or compliance-related issues, thereby enabling more targeted surgical planning and risk stratification.

Glaucoma was identified as a significant negative factor affecting the success of External DCR. The study revealed that patients with glaucoma had a significantly lower likelihood of surgical success, with an odds ratio (OR) of 0.0317 in multivariable analysis (P = 0.018). This finding aligns with Seider et al.,[31] who reported that the use of glaucoma eye drops containing timolol was associated with an increased risk of nasolacrimal duct obstruction. Prolonged timolol use and higher daily dosages were also identified as risk factors for primary acquired nasolacrimal duct obstruction (PANDO). Furthermore, Kashkouli et al.[32] found that glaucoma eye drops were correlated with lacrimal drainage system obstruction, particularly affecting the upper drainage system (punctum and canaliculus). These studies suggest that the anatomical location and severity of lacrimal drainage system obstructions are influenced by the type and duration of glaucoma treatment. Lacrimal drainage obstruction has been observed in patients using topical glaucoma medications, including canalicular stenosis and nasolacrimal duct obstruction (NLDO).[33-35] This suggests that glaucoma and the use of anti-glaucoma medications may lead to changes in the periocular tissues, thereby increasing the complexity of the surgical procedure. In contrast, Ohtomo et al.[36] found no difference in a history of glaucoma among patients undergoing repair of NLDO compared to patients undergoing cataract surgery, nor in history of timolol use. Ortiz-Basso et al.[37] described topical anti-glaucoma medications are associated with the development of lacrimal drainage obstruction, no single drug appeared to have a higher risk of obstruction. Although this study did not compare preservative-containing and preservative-free topical anti-glaucoma medications, they hypothesize that preservatives have an important role in the development of obstruction. However, further studies comparing anti-glaucoma drugs with and without preservatives are required to clarify their risks of lacrimal drainage obstruction.

Patient gender also emerged as a factor influencing the success of External DCR. The study found that female patients had a significantly higher likelihood of surgical success compared to males. In univariable analysis, females exhibited an odds ratio (OR) of 16.6875, indicating a substantially higher tendency for successful outcomes (P = 0.002). However, multivariable analysis revealed that when considering other contributing factors, gender was not statistically significant, aligning with the findings of Kashkouli et al.[38]

A history of dacryocystitis was not found to be a statistically significant factor in this study. This aligns with the findings of Rabina et al.,[39] where patients with a history of dacryocystitis were more prevalent in the success group compared to the failure group, with a P value of 0.435. However, Badhu et al.[40] reported that surgical success rates were lower in patients with a history of dacryocystitis, suggesting that further studies with larger sample sizes may be necessary to clarify the impact of dacryocystitis on surgical outcomes. Chronic inflammation and infection of the lacrimal sac could potentially alter tissue structures, which might influence the success of the surgery.

Regarding the duration of symptoms, the analysis showed no statistically significant correlation between the average duration of symptoms before surgery and the surgical outcomes (P = 0.320). This indicates that the duration of symptoms is not a clear predictor of surgical success, consistent with the findings of Rabina et al.[39] Nonetheless, Seider et al.[41] also found that prolonged symptom duration was associated with lower surgical success rates. Larger-scale studies may be required later.

The strength of this study is the consistency of surgical procedures performed by the same surgeon. However, this study has several limitations, primarily due to its retrospective design, which may result in incomplete or missing data and a relatively small sample size. To validate and strengthen these findings, prospective studies with larger cohorts and randomized controlled trials are warranted.

The findings highlight the importance of careful patient screening and assessment, particularly when considering factors such as age, gender, and comorbidities like glaucoma, which significantly influence surgical success. To improve the success rate of external dacryocystorhinostomy in patients with common canalicular obstruction, NLDO and those with glaucoma, several strategies should be considered. Silicone intubation should be employed and maintained for 3-6 months to support ductal patency. Intraoperative assessment of the canalicular system with probing or microtrephination can address subtle obstructions. Wide osteotomy and precise, tension-free mucosal flap suturing remain critical for long-term success. In glaucoma patients, the intraoperative use of Mitomycin-C may reduce fibrosis associated with chronic inflammation from topical medications. Prolonged postoperative use of topical and intranasal steroids is advisable to control subclinical inflammation. Additionally, preoperative modification or substitution of preserved anti-glaucoma drops with preservative-free formulations may minimize tissue reactivity. Finally, early postoperative nasal endoscopy allows timely detection of granulation tissue or synechiae, enabling prompt intervention to prevent restenosis and surgical failure. Future research should aim to clarify the underlying mechanisms contributing to surgical failure in external DCR, particularly in younger patients and those with coexisting conditions such as glaucoma. Prospective, multicenter studies with larger sample sizes are warranted to validate the observed associations and enhance generalizability. Detailed subgroup analyses focusing on anatomical variations, canalicular involvement, and medication-related mucosal changes may offer insights into risk stratification and individualized surgical planning. In addition, high-resolution imaging and endoscopic evaluation pre- and post-operatively could be incorporated to better characterize anatomical contributors to failure. Studies comparing different surgical modifications such as flap techniques, use of adjunctive agents like Mitomycin-C, and stent duration in high risk groups would further inform best practices. Finally, patient compliance, follow-up adherence, and quality-of-life outcomes should be integrated into future research to develop a more comprehensive understanding of factors influencing both functional and anatomical success.

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