·Clinical Research·

Outcomes of endoscopic endonasal dacryocysto-rhinostomy for intractable lacrimal dacryostenosis and associated factors

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Received: 2015-07-30 Accepted: 2016-01-30

Abstract

• AIM: To examine the effects of patient age, canalicular obstruction, mode of anesthesia, and duration of nasolacrimal intubation on the outcomes of endoscopic endonasal dacryocystorhinostomy (DCR).

• METHODS: Totally 56 eyes of 46 patients with prolonged epiphora underwent minimally invasive endoscopic endonasal DCR. A successful surgical outcome was defined as a significant improvement in symptoms, adequate water passage from the puncta to the nasal cavity, and patency of the DCR ostium. All outcomes were assessed at least 6mo after extubation. Fisher´s exact test was used to discuss the factors, and then the logistic regression analysis was made by SAS 9.4 software.

• RESULTS: The overall success rate was 75.0%, and complete resolution was observed in 27 eyes. The success rate was higher for patients with ≥6mo intubation than for those with <6mo intubation. However, there were no significant differences in outcomes between groups stratified by age (<65 or ≥65y), presence or absence of canalicular obstruction, mode of anesthesia (local or general), and use or nonuse of a radiowave unit. One patient developed subcutaneous emphysema around the eye and nose and one developed subcutaneous hemorrhage after surgery.

• CONCLUSION: Endoscopic endonasal DCR can be considered safe and minimally invasive with reasonable success rates, particularly when the duration of nasolacrimal intubation is ≥6mo.

• KEYWORDS: dacryocystorhinostomy; endoscopy; intubation; epiphora
DOI:10.18240/ijo.2016.10.17

Tanigawa T, Sasaki H, Nonoyama H, Horibe Y, Nishimura K, Hoshino T, Ogawa T, Murotani K, Ueda H, Kaneda M. Outcomes of endoscopic endonasal dacryocystorhinostomy for intractable lacrimal dacryostenosis and associated factors. *Int J Ophthalmol* 2016;9(10):1471-1475

INTRODUCTION

Epiphora (watering eyes) is a common problem, particularly in elderly individuals. A blocked tear duct is the most common cause [1]. Previously, most patients showed no symptomatic improvement with conservative treatment (warm compresses, massage, and nasal passage probing) underwent external dacryocystorhinostomy (DCR). However, because incision of the facial skin is required, patients are reluctant to undergo external DCR[2]. Endoscopic endonasal DCR is less invasive than external DCR; therefore, it has rapidly gained acceptance for the treatment of intractable nasolacrimal duct obstruction and chronic dacryocystitis [3-5]. Although beneficial in many patients, several aspects of this treatment remain unclear. The success rate for endoscopic DCR with or without laser assistance has been reported to be 65%-97%[3,5-10]. However, the role of patient characteristics and surgical factors in the success of DCR remains unclear. In particular, inconsistent findings have been reported with regard to the association of nasolacrimal intubation with the success rate of endoscopic DCR[6-7,11-14].

The aim of this study was to examine the effects of age, sex, canalicular obstruction, mode of anesthesia, use of a radiowave unit, and duration of nasolacrimal intubation on the outcomes of endoscopic intranasal DCR.

SUBJECTS AND METHODS

Subjects A total of 46 patients (9 men and 37 women; age

49-80 years) with epiphora lasting for ⩾6mo were selected for this retrospective study. They had visited Tono Kosei Hospital, Gifu, from January 2000 to December 2012. Epiphora was diagnosed on the basis of clinical symptoms and the presence of obstruction detected by irrigation. Patients with chronic dacryocystitis and recurrent exacerbations were included, while those with congenital nasolacrimal duct obstruction, tumor, hypersecretion from the ocular surface or granulomatous disease, and/or facial nerve weakness were excluded. Ten patients underwent bilateral surgery; therefore, the total number of eyes was 56 (31 right eyes, 25 left eyes). Of these 56 eyes, 15 eyes (26.8%) exhibited discharge. In addition, 53 eyes underwent primary surgery and three underwent revision surgery (failure of previous DCR; Table 1). The study protocol was approved by the Ethics Review Committee of our hospital.

Table 1 Patient characteristics

Characteristics	*n* (%)
Sex	
M	45 (80.4)
F	11 (19.6)
Age (a)	
<65	22 (39.3)
⩾65	34 (60.7)
Laterality	
Unilateral	36 (64.3)
Bilateral	10 (35.7)
Epiphora	56 (100)
Previous DCR	3 (5.4)
Nasal deviation	3 (5.4)
Nasal polyp	1 (1.8)

Surgical Methods Before surgery, we performed nasal/paranasal computed tomography and flexible fiberscopy to assess the intranasal pathology. A rigid endoscope (Olympus Medical Science Co., LTD., Tokyo, Japan) with an attached camera was then inserted to visualize the surgical field. Experienced ear-nose-throat surgeons and an ophthalmologist performed all surgical procedures together. To improve endoscopic visualization, septoplasty was performed in 3 patients and nasal polyps were removed from one (Table 1). To anesthetize the nasal mucosa and achieve hemostasis, 2 mL of 0.5% xylocaine was injected into the agger nasi and the anterior end of the middle turbinate.

A 20-gauge vitrectomy light probe was placed through the canaliculus and advanced through the sac to the medial wall. For patients with canalicular obstruction, a canalicular trephine (BD Visitec, Warks, UK) was inserted into the punctum with the stylet in place and carefully advanced within the canaliculus to the obstruction site (canaliculoplasty). When blockage was encountered, the stylet was removed and the trephine was rotated in a boring manner until the tip emerged into the lacrimal sac. Extreme care was taken to avoid the formation of a false passage[6].

When we moved the light pipe in and out of the lacrimal sac, it was easy to identify the lacrimal sac region from the nasal cavity[15]. A sickle knife was used to incise the nasal mucosa, and the nasal mucosa in the transilluminated area was removed. Osteotomy was performed using a power drill system (Xomed power drill system Model 2000; XPS) to remove the thicker bone of the maxilla. Once the lacrimal sac was encountered after the creation of a small bony osteostomy (8×6 mm), the lacrimal sac wall was tented into the surgical site using a lacrimal probe. The sac wall was incised using a radiowave unit (Surgitoron, Ellman Japan, Tokyo) or a sickle knife. Until 2004, a radiowave unit was used to decrease bleeding and maintain the size of the osteotomy, but not after 2004. Physiological saline was used to irrigate the lacrimal passage and confirm patency. From the superior and inferior lacrimal puncta, a nunchaku-style silicone tube (0.9-mm outer diameter; Kaneka Medics NS-tube, 910-090N) was inserted and used to stent the intranasal opening.

Broad-spectrum antibiotic therapy (intravenous flomoxef sodium, 1 g ×2) for 3d was prescribed to all patients. In addition, ofloxacin ophthalmic suspension (5-7d) was prescribed. Fibrin clots and crusts were gently removed for 5-7d daily after surgery[16].

After discharge, crusts were regularly removed every week until complete mucosal healing was observed. Most patients achieved complete mucosal hearing a month after surgery. Thereafter, follow-up examinations were conducted every month. The silicone tube was intended to remain in place for 6mo. We postponed tube removal if we did not observe spontaneous water flow in an irrigation test.

Strict Outcome Criteria Postoperative status was evaluated on the basis of subjective (epiphora, crust and pus drainage from puncta) and objective (water irrigation test outcomes and ostium patency at endoscopic evaluation) findings.

A successful surgical outcome was defined as a significant improvement in subjective symptoms (significant improvement was defined as an improvement of at least 80% compared with the baseline)[17], an adequate water passage from the puncta to the nasal cavity, and patency of the DCR ostium [18]. We assessed all outcomes at least 6mo after extubation.

Statistical Anaylsis The influence of six factors on the success of endoscopic DCR was evaluated using Fisher's exact test: age (<65 or ⩾65y), sex (male or female), presence or absence of canalicular obstruction, mode of anesthesia (local or general), use or nonuse of a radiowave unit, and duration of nasolacrimal intubation. To further explore possible underlying factors, we adopted logistic regression analysis using the above mentioned six items as

explanatory variables. All statistical analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). A *P* value of <0.05 was considered statistically significant.

RESULTS

Overall Treatment Outcomes Successful surgical outcomes were recorded for 42 eyes. The overall success rate was 75.0%, and complete resolution was observed in 27 (48.2%) eyes. No major complication such as blindness or double vision was observed, although one patient developed subcutaneous emphysema around the eye and nose and one developed subcutaneous hemorrhage after surgery.

Effects of Patient Characteristics The success rate was 81.8% (9/11 eyes) for men and 73.3% (33/45 eyes) for women, with no significant difference (*P*=0.7115). The success rate was 76% for patients aged ≥65 years (26 of 34 eyes) and 73% for those aged <65 years (16 of 22 eyes, *P*=0.7620; Table 2).

Canalicular obstruction was observed in 22 eyes and was associated with an overall success rate of 72.7% (16 of 22 eyes), which was not significantly different from that of eyes without obstruction (76.5%, 26 of 34 eyes, *P*=0.7620; Table 2). When classified according to the obstruction site, we observed 78.9% (15 of 19 eyes) success for common canalicular stenosis, and 33.3% (1 of 3 eyes) for upper and/or lower canalicular stenosis in distal segment. Incidentally, the intubation period in patients with or without canalicular obstruction did not differ statistically (6.7±1.5 *vs* 6.1±0.5mo).

Effects of Surgical Factors The overall success rate was greater for surgeries performed under general anesthesia (79.3%, 23 of 29 eyes) than for those performed under local anesthesia (70.4%, 19 of 27 eyes), with no significant differences (*P*=0.5423). The overall success rate was greater for surgeries performed without a radiowave unit (77.8%, 28 of 36 eyes) than for those performed with a radiowave unit (70.0%, 14 of 20 eyes), with no significant differences (*P*=0.5364; Table 2).

Finally, a higher success rate was observed with ≥6mo nasolacrimal intubation (88.5%, 23 of 26 eyes) than with <6mo intubation (63.3%, 19 of 30 eyes, *P*=0.0361; Table 2). Furthermore, multivariate analysis of factors affecting the treatment outcomes revealed that ≥6mo nasolacrimal intubation was a significant factor influencing the outcomes of endoscopic DCR [odds ratio, 6.65; 95% confidence interval (CI), 1.28-33.4, *P*=0.024; Table 3).

Table 2 Effects of various factors on the outcomes of endoscopic DCR

Patient subgroup	No. of eyes	Surgical results		*P*
		Success	Failure	
Sex				0.7115
M	11	9	2	
F	45	33	12	
Age (a)				0.7620
<65	22	16	6	
≥65	34	26	8	
Radiowave unit				0.5364
Use	20	14	6	
Nonuse	36	28	8	
Anesthesia				0.5423
General	29	23	6	
Local	27	29	8	
Canalicular obstruction				0.7620
Present	22	16	6	
Common canalicular	19	15	4	
Lower/upper canalicular	3	1	2	
Absent	34	26	8	
Tube intubation (mo)				0.0361
<6	30	19	11	
≥6	26	23	3	

Table 3 Multivariate logistic regression analysis to determine the effects of various factors on the outcomes of endoscopic intranasal DCR in 56 eyes

Factors	Comparison	*P*	Odds ratio (95%CI)
Tube intubation period (mo)	<6 *vs* ≥6	0.024	6.65 (1.28-34.4)
Sex	M *vs* F	0.272	2.85 (0.44-18.6)
Age (a)	<65 *vs* ≥65	0.307	0.96 (0.88-1.04)
Anesthesia	General *vs* local	0.526	1.79 (0.30-10.7)
Canalicular obstruction	Absent *vs* present	0.731	1.29 (0.30-5.61)
Radiowave unit	Use *vs* nonuse	0.901	0.89 (0.14-5.74)

DISCUSSION

Overall Treatment Outcomes In the present study, endoscopic endonasal DCR was associated with an overall success rate of 75.0% in patients with lacrimal duct obstruction refractory to conservative medical treatment. This rate was similar to that (77%) reported by Kong *et al*[3], who treated more than 100 patients using endoscopic endonasal DCR and reported marked or moderate symptom improvement after 3-5mo of intubation.

Factors Affecting Dacryocystorhinostomy Outcomes In our study, the success rate for endoscopic DCR was significantly higher with ≥6mo nasolacrimal intubation than with <6mo intubation. There were no significant differences in the success rate between groups stratified by age, canalicular or common canalicular obstruction, mode of anesthesia, and use or nonuse of a radiowave unit.

Outcomes According to Patient Characteristics The outcomes of DCR were not significantly different between patients aged ≥65 years and those aged <65 years. Generally, the success rate is significantly higher in younger patients [5,19-20]. A possible reason for this result is that the nasal mucosa is more friable with decreased contractility of blood vessels in elderly individuals, leading to increased bleeding. However, we achieved a high success rate even for elderly individuals aged ≥65 years in our study. A possible explanation is the difference in patient stratification by age among different studies; previous studies defined young patients as those aged <50 or <55 years [5,20]. Another reason can be as follows. With an increase in age, the number of fibroblasts decreases and some fibroblasts exhibit

degeneration. A decrease in the number and activation of fibroblasts results in decreased synthesis of fibrous components. Therefore, with an increase in age, scarring is less and the epithelium at the osteotomy site is less likely to regenerate[19].

Our surgery with recanalization of presaccal canalicular obstruction was effective in 72.7% (16 of 22) eyes. Canalicular obstruction is the most difficult area of lacrimal drainage obstruction to treat [21]. Why did we get good results in both patients with and without canalicular obstruction? We think the most important reason is that the normal portion of the canaliculus was sufficiently dilated before trephination and the trephine was advanced as gently as possible following the presumed normal anatomical direction into the lacrimal sac [6]. In fact, Yung and Hardman-Lea[21] reported a success rate of 73% in patients with canalicular obstruction. Baek *et al*[6] reported that complete success was achieved in 29 of 31 eyes (93.5%) after endoscopic DCR followed by canalicular trephination and silicone stent intubation. These findings indicate that DCR surgery with recanalization of presaccal canalicular obstruction can be used to treat patients with dacryostenosis [22], although surgeons should avoid creating false passages through the submucosa of the canaliculus[6].

Effects of Surgical Factors Meticulous homeostasis is crucial for successful DCR. DCR under local anesthesia minimizes intraoperative bleeding[23]. On the other hand, pain during surgery under local anesthesia can lead to inadequate surgery. From the viewpoint of these advantages and disadvantages, we speculated that the mode of anesthesia affects the outcomes of DCR. In this study, excellent success rates were obtained for endoscopic DCR under local (74%) as well as general (83%) anesthesia. Maini *et al*[8] performed endoscopic DCR under local and general anesthesia and reported no significant differences in improvement in the symptom score between the two modes. On the basis of our findings and those of previous studies, we believe that the mode of anesthesia should be selected at the patient's discretion.

The postoperative outcomes in our study were not different between surgeries performed with a radiowave unit and those performed without one. Various types of hot knives have been used to prevent intraoperative bleeding from the site of lacrimal sac removal [3,20]. Furthermore, favorable results have been reported after endoscopy-assisted endonasal laser surgery with an argon laser, a KTP laser[7], a Ho:YAG laser [5], and an Nd:YAG laser [20]. On the other hand, recent reports indicated that laser-assisted surgery is associated with increased thermal damage to the sac, which can lead to unnecessary scarring and subsequent restenosis and potential failure[9-10,24].

The necessity of nasolacrimal intubation remains controversial [6-7,11-14]. Häusler and Caversaccio [13] described that this procedure resembles the classic procedure used for the treatment of effusion in the tympanic cavity using transtympanic ventilation tubes. They suggested that long-term drainage and repetitive or even permanent intubation is necessary in patients with dacryostenosis. On the other hand, Feng *et al*[11] reported that intubation is not preferable because infection and/or granulation tissue can develop around the inserted tubes. In our experience, crust removal for 1mo after surgery can lead to normal epithelialization of the nasal mucosa and prevent the subsequent development of granulation tissue around the osteotomy site. We accordingly recommend intubation after DCR with careful monitoring for granulation tissue formation.

Previous studies reported that the optimum duration of nasolacrimal intubation after DCR varies from 4wk to >6mo. Farzampour *et al*[20] reported a significant difference in outcomes between patients intubated for 6mo and those intubated for <5mo. However, Ressiniotis *et al*[7] reported that the likelihood of surgical failure was not higher in patients who did not tolerate intubation and those who were extubated early (1-4mo). Our study found a significantly higher success rate in patients with ≥6mo intubation than in those with <6mo intubation; we speculate that intubation for ≥6mo was necessary for epithelization of the lumen wall after reopening of the stenosed segment.

Study Limitations This study has several limitations. We did not perform a "fluorescent disappearance test" for evaluation of anatomical success. We could not investigate the types (membrane or fibrotic) of canalicular obstruction. The results are primary, and further studies are essential to conclusively prove the results and make statistically relevant claims.

In conclusion, an overall success rate of 75.0% was achieved for endoscopic endonasal DCR in patients with lacrimal dacryostenosis refractory to conservative medical treatment, with no major postoperative complications. Furthermore, the duration of nasolacrimal intubation was found to be a significant factor influencing the success rate for this procedure, whereas patient age, canalicular obstruction, mode of anesthesia, and use of a radiowave unit were not significant factors. These results suggest that endoscopic endonasal DCR can be considered as a safe and minimally invasive procedure with reasonable success rates, particularly when the duration of nasolacrimal intubation is 6mo or more.

ACKNOWLEDGEMENTS

Conflicts of Interest: Tanigawa, T, None; **Sasaki H,** None; **Nonoyama H,** None; **Horibe Y,** None; **Nishimura K,** None; **Hoshino T,** None; **Ogawa T,** None; **Murotani K,** None; **Ueda H,** None; **Kaneda M,** None.

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