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OCULOPLASTICS AND ORBIT

Effects of ostium granulomas and intralesional steroid injections on the surgical outcome in endoscopic dacryocystorhinostomy

Aerin Jo[1] · Shin-Hyo Lee[2] · Wu-Chul Song[2] · Hyun Jin Shin[1]

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Abstract

Purpose To determine the effect of granuloma formation in the ostium and intralesional steroid injections (ISIs) on the surgical outcome after endoscopic dacryocystorhinostomy (DCR) in patients with primary acquired nasolacrimal duct obstruction (PANDO).

Methods One hundred and eighty-three cases involving 142 patients were enrolled. The ostium granulomas were classified according to their location relative to the internal common opening (superior, anterior, and posterior positions) and to the vicinity of the ostium (inner, edge, and extra types). If an ostium granuloma was observed during the follow-up and its size increased, ISIs were performed using 0.3 ml of 40 mg/ml triamcinolone acetonide. The surgical outcomes were compared between cases with and without ostium granulomas and also between each granuloma position and type.

Results Ostium granulomas occurred in 71 (38.8%) of the 183 cases, and an ISI was applied in 65 cases with a mean of 2.1 injections. All of the granulomas regressed successfully after ISIs, with the success rate not differing between the cases with (85.9%) and without (83.9%) granuloma. There was no association between granuloma location and surgical outcome. However, the functional outcome was worse (60%) for inner granulomas (which are located within the ostial base) than for extra (87.8%) and edge (98%) granulomas.

Conclusions ISIs can be easily applied by a surgeon to help regress an ostium granuloma and improve the ostial patency after DCR. Inner ostium granulomas are associated with a worse functional outcome, and the initiation of an early corrective intervention such as an ISI should be considered.

Keywords Dacryocystorhinostomy · Intralesional steroid injection · Ostium granuloma · Functional outcome

Introduction

Endoscopic dacryocystorhinostomy (DCR) is becoming increasingly popular for treating primary acquired nasolacrimal duct obstruction (PANDO) due to its advantages over an external approach of cutaneous scar avoidance, direct visualization of the nasal anatomy, and preservation of lacrimal pump function [1, 2]. However, surgical failures still occur in 10–20% of cases [2–8] despite various modifications having been made to the surgical technique for ensuring ostial patency, such as the application of silicone-tube stenting [9] and the use of mitomycin C [10]. The most common cause of DCR failure is abnormal ostial healing that leads to fibrosis, granuloma formation, and cicatricial closure of the osteotomy site [1, 11, 12]. Postoperative evaluations of rhinostomy and ostium granuloma are therefore important for surgeons to initiate early corrective interventions and predict surgical outcomes.

Topical corticosteroid nasal spray is widely used after endoscopic DCR to prevent abnormal wound healing and ostium granuloma formation [13]. Corticosteroid is known to suppress inflammation and fibroblast recruitment and is also thought to reduce scar formation [14]. However, the primary limitation of nasal sprays is that they distribute the drug mainly on the anterior edges of the inferior and middle turbinates. An intralesional injection will theoretically result in the steroid being applied more directly to the nasal mucosa and thereby having a stronger and longer therapeutic effect than topical

✉ Hyun Jin Shin
shineye@kuh.ac.kr

[1] Department of Ophthalmology, Konkuk University Medical Center, Konkuk University School of Medicine, 120-1 Neungdong-ro, Gwangjin-gu, Seoul 05030, Republic of Korea

[2] Department of Anatomy, Konkuk University School of Medicine, Seoul, Republic of Korea

steroid nasal spray in controlling granulomas and scar formation over the ostium created by surgery. Lee et al. reported that injecting triamcinolone intraoperatively into the nasolacrimal sac wall and/or nasal mucosa improved the success rate of DCR without introducing any new complications [15]. Moreover, Zeldovich and Ghabrial suggested that the success rate of revision endoscopic DCR was higher when betamethasone was injected into the ostium site intraoperatively [14]. However, these previous studies mainly focused on the intraoperative administration of steroid and overall surgical outcomes, with little discussion of the postoperative use of steroid for managing abnormal ostial healing including granuloma and cicatrix formation at the ostium after DCR.

In the current study, we assessed the effectiveness of intralesional steroid injections (ISIs) in reducing ostium granulomas that do not respond to steroid nasal spray. We also investigated the effects of ostium granulomas on the surgical outcome in endoscopic DCR.

Materials and methods

Between July 2012 and January 2017, we enrolled 183 cases involving 142 patients who underwent endoscopic DCR for PANDO performed by a single surgeon. The study protocol was consistent with the principles of the Declaration of Helsinki, and it was approved by the institutional review board and ethics committee at University Medical Center. All of the included patients underwent a comprehensive preoperative ophthalmic examination that included a slit-lamp examination, diagnostic nasolacrimal irrigation and probing, the dye disappearance test, and an intranasal examination. The following exclusion criteria were applied: (1) history of previous failed DCR; (2) DCR performed at < 18 years of age; (3) nasal pathology and preexisting sinus or nasal abnormalities; (4) canalicular disease (obstruction or stenosis) detected either preoperatively or intraoperatively; (5) other causes of epiphora such as punctal occlusion, ectropion, or facial palsy; (6) application of external DCR; and (7) a follow-up duration of shorter than 6 months.

Surgical procedure

Endoscopic DCR was performed using a 30° 4-mm-diameter nasal endoscope (Hopkins II Forward-oblique, Karl Storz, Tuttlingen, Germany) under general anesthesia using a standardized protocol. First, shrinkage of the nasal mucosa was performed with the aid of packing gauze soaked in a mixture of 4% lidocaine and 1:1000 epinephrine solution for 5 min. A 20-gauge straight endoilluminator light probe was then passed through the superior canaliculus into the lacrimal sac. The lateral nasal mucosa near the lacrimal sac fossa was incised and removed. Bony structures covering the lacrimal sac were then gently removed with a Kerrison rongeurs punch until the sac was widely exposed from the level of the fundus to the proximal nasolacrimal duct. The lacrimal sac was tented using a Bowman probe, and a vertical incision was made in its medial wall using a keratome blade (Alcon, Fort Worth, TX, USA). The sac was then removed, and the wall flap was trimmed and flattened on the wall of the lateral nasal mucosa. After intubation with silicone bicanalicular tubes, the nasal cavity was lightly packed with an antiadhesive agent (Nasopore, Polyganics, Groningen, Netherlands) soaked in a mixture of triamcinolone and gentamycin.

Postoperative follow-up and intralesional steroid injections

Patients were examined every 2 weeks during the first 3-month postoperative follow-up period. The silicone tubes were then removed, and a monthly follow-up was performed for the next 3 months. The postoperative regimen included applying a topical mixture of antibiotics and steroid eyedrops (Maxitrol, Alcon, Fort Worth, TX, USA) four times daily for 1 month combined with steroid nasal spray (Avamys, Glaxo Smith Kline, London, UK) once daily for 3 months. Patients performed nasal douching with saline to flush debris from the surgical site after being discharged home.

Standard endoscopic examinations were performed at each follow-up visit to assess the wound healing of the postoperative DCR ostium, with specific reference to the presence to granulation tissue. If an ostium granuloma was observed whose size increased at the next visit, we injected 0.3 ml of 40 mg/ml triamcinolone acetonide intralesionally under direct endoscopic visualization (Fig. 1), with special care taken to avoid damaging the adjacent local tissue. We assessed the response at the next visit and considered administering repeated steroid injections until the granuloma was resolved.

Outcome measurements

Successful surgical outcomes were categorized into anatomic, functional, and overall success. Anatomic success was defined as endoscopic evidence of ostial and canalicular patency with evidence of patent syringing at the last follow-up. Functional success was defined as endoscopic visualization of fluorescein dye at the ostium after instilling fluorescein eyedrops and subjective improvement of epiphora. Overall success was achieved if the patient exhibited both anatomic and functional success at the last follow-up visit.

Ostium granuloma was classified according to its location relative to the internal common opening (superior, anterior, and posterior positions; Fig. 2a) and to the vicinity of the ostium (inner, edge, and extra types; Fig. 2b). Inner and extra granulomas were located at the inner and outer base of the ostium, respectively, while edge granulomas were located at

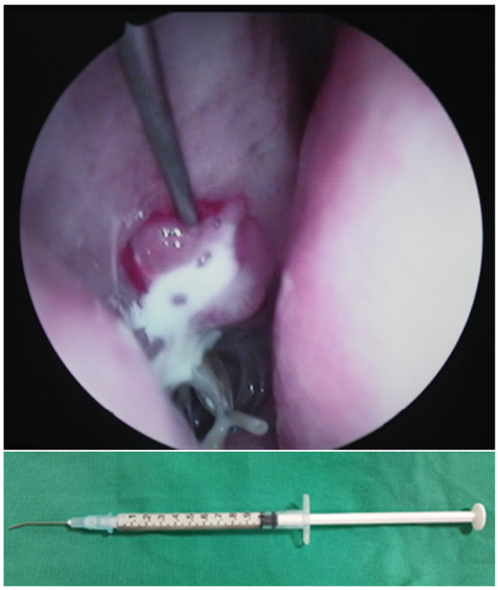

Fig. 1 Photograph of an intralesional steroid injection (ISI) into the ostium granuloma using a 1.0-ml syringe with a bent 23-gauge rigid needle

the border between the nasal mucosa and the base of the ostium. We assessed the relationship between the surgical outcome and the positions and types of ostium granulomas. We additionally compared the surgical outcome between cases with ostium granuloma treated with ISIs and those without ostium granuloma.

Statistical analysis

Statistical analysis was performed using SPSS (version 17.0, SPSS, Chicago, IL, USA). Group differences were tested for by applying Pearson's chi-square or Fisher's exact test to categorical variables and the independent *t* test, Mann-Whitney test, or Kruskal-Wallis test (after testing for normality using the Shapiro-Wilk test) to continuous variables. A probability value of $p < 0.05$ was considered to indicate a significant difference.

Results

The study cohort comprised 47 male (33.1%) and 95 female (66.9%) patients, 41 of whom had bilateral DCRs, yielding a total of 183 cases. The patients were aged 58.1 ± 14.5 years (mean ± SD, range 28–78 years), their follow-up duration was 14.9 ± 7.1 months (range 6–30 months), and all of them were Korean. Granuloma occurred in 71 (38.8%) of the 183 cases. The time interval from the operation to when a granuloma was observed was 46.3 ± 15.9 days (range 15–84 days) (Fig. 3). Six of the 71 granuloma cases showed spontaneously regression, and ISIs were performed in the remaining 65 cases. Each patient received 2.1 ± 1.2 injections on average.

Figure 4 and Table 1 present the classifications of postoperative ostium granulomas and surgical outcomes. With regard to the position, ostium granulomas were observed more often superiorly (46.5%), followed by anteriorly (32.4%) and posteriorly (21.1%). There were no significant differences in the anatomic and functional success rates between the superior, anterior, and posterior direction groups ($p = 0.675$ and 1.000, respectively). The anatomic success rates were 95.1, 95, and 90% for the 41 extra, 20 edge, and 10 inner granulomas, respectively ($p = 0.781$). The functional success rate was significantly worse for inner granulomas (60%) than for edge (98%) and extra (87.8%) granulomas ($p = 0.039$). In addition, the number of steroid injections did not differ significantly with respect to the granuloma position or type ($p = 0.821$ and 0.411, respectively).

Table 2 lists the clinical characteristics and surgical outcomes of the cases with and without ostium granuloma after endoscopic DCR. The preoperative characteristics of age, sex, past medical history, duration of tearing, or symptoms of chronic discharge cases did not differ significantly between the two groups (all $p > 0.05$). The anatomic and functional success rates were 94.4 and 85.9%, respectively, for ostium granulomas treated with ISIs and 92.9 and 87.5% for the cases without ostium granuloma. The anatomic, functional, and overall success rates did not differ between ostium granulomas receiving ISI and cases without ostium granuloma ($p = 0.731$, 0.805, and 0.643, respectively).

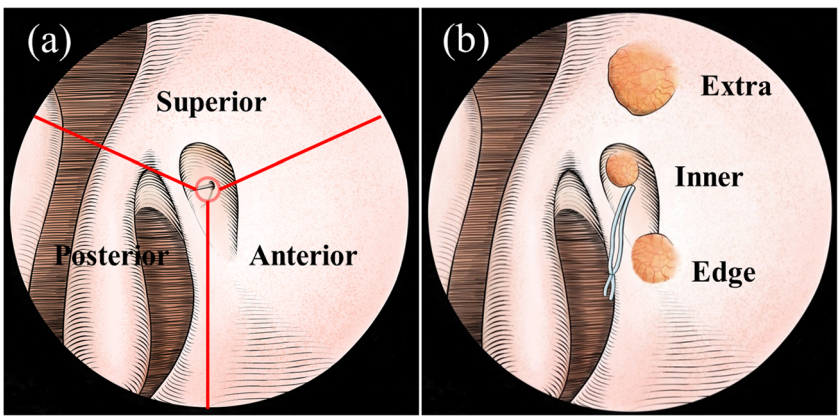

Fig. 2 Classification of postoperative ostium granulomas into three groups based on their position (**a**) and type (**b**)

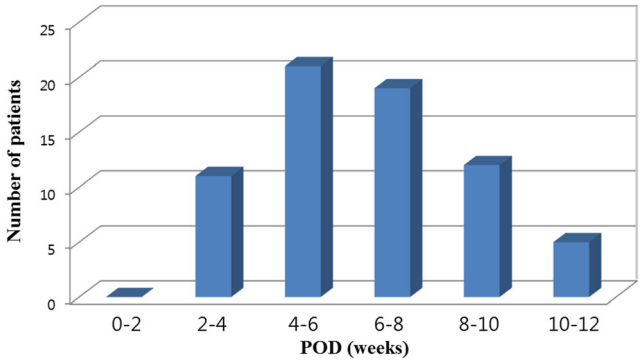

Fig. 3 Time interval from the operation to when a granuloma was observed

All of the ostium granulomas were successfully regressed after ISIs, and there was no case that was unresponsive to the ISI that needed surgical excision or other treatment. There were no major complications, including infection, mucosal melting, fat atrophy, visual loss, uncontrolled epistaxis, or increased intraocular pressure or blood glucose level. The minor complication of periorbital bruising occurred in one patient, and this resolved spontaneously within 1 week.

Discussion

The aim of the present study was to elucidate the effects of ostium granuloma and ISIs on the surgical outcome in patients with PANDO after endoscopic DCR. In our cohort of patients, the position of the ostium granuloma (superior, anterior, or inferior) was not associated with the surgical outcome. However, there was a significant association between the type of ostium granuloma (inner, edge, and extra) and functional success. We also found that an ISI was effective in regressing ostium granulomas that did not respond to topical steroid nasal spray, irrespective of their position or and type.

Steroid injections have proved useful in various areas of ophthalmic and rhinosinus practice over the past decade. A triamcinolone injection was considered equally effective and an alternative to incision and curettage for managing chalazion [16]. Steroids are also frequently injected into the nasal mucosa for treating allergic rhinitis and persistent nasal polyps [17, 18]. In lacrimal surgery, an ISI offers the advantage of being quick and simple, with less bleeding and pain compared to the surgical removal of an ostium granuloma using forceps, cautery, or a microdebrider [14, 19, 20]. It is more difficult to assess a granuloma using surgical instruments in patients with a narrow nasal cavity or a posteriorly located ostium. On the other hand, steroids such as triamcinolone acetonide are readily available and extremely cost-effective compared to surgical interventions. ISIs do not require any additional surgical skill, since the technique is very similar to injecting the initial topical anesthetic and it utilizes the same equipment. Our technique can also be repeated if required and does not preclude the use of a subsequent intervention in the event of failure [20].

The present study obtained favorable results in the cases with ostium granuloma treated with an ISI, with an overall success rate of 85.9%. This is similar to the results for the patients without granuloma in the present study (overall success rate of 83.9%) and previous studies finding that the success rate of endoscopic DCR ranged from 77 to 90% (Table 3). It is difficult to compare published success rates for DCRs due to differences in the criteria applied in different studies. In the present study, we defined anatomic success as patency with syringing and endoscopic evidence of ostial patency, functional success as visualization of fluorescein dye at the ostium and relief from epiphora, and overall success as achieving both anatomic and function success, which has been suggested by the Royal College of Ophthalmologists as being a good indicator of successful surgery [21]. Using these strict criteria, our success rate is noteworthy when considering that granulation formation around the ostium has

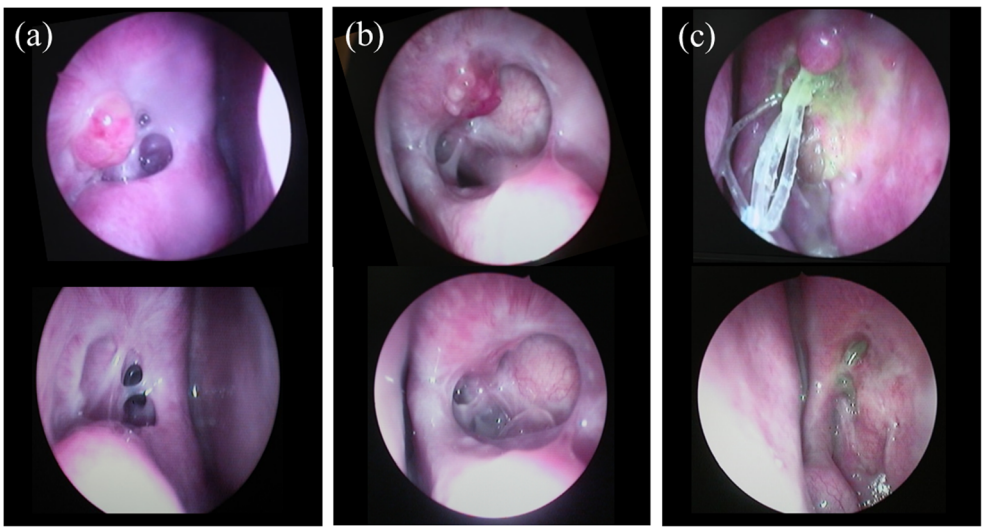

Fig. 4 Endoscopic views of representative cases before (upper) and after (lower) an ISI. **a** An anterior extra granuloma. **b** A posterior edge granuloma. **c** A superior inner granuloma

Table 1 Relationships of ostium granulomas of different types and positions with surgical outcome

		Cases, *n* (%)	Mean number of injections	Anatomic success (%)	Functional success (%)	Overall success (%)
Position	Superior	33 (46.5)	2.1	90.9	84.8	84.8
	Anterior	23 (32.4)	2.8	95.7	87.0	87.0
	Posterior	15 (21.1)	1.6	100.0	86.7	86.7
			$p = 0.821$[a]	$p = 0.675$[b]	$p = 1.000$[b]	$p = 1.000$[b]
Type	Extra	41 (57.7)	1.8	95.1	87.8	87.8
	Edge	20 (28.2)	2.0	95.0	98.0	95.0
	Inner	10 (14.1)	2.3	90.0	60.0	60.0
			$p = 0.411$[a]	$p = 0.781$[b]	*p = 0.039*[b]	*p = 0.039*[b]

Significant *p* values are in italics

[a] Kruskal-Wallis test

[b] Fisher's exact test

been reported as a poor prognosis factor and a common cause of surgical failure [11, 12].

The anatomic success rate in the present study did not differ between inner, edge, and extra granulomas. Ostial obstruction secondary to a granuloma is more likely to occur in inner granulomas (located in the vicinity of the internal common opening) than in edge and extra granulomas [14]. However, inner granulomas were successfully regressed after an ISI without impinging on the internal common opening. It is therefore considered that an ISI is helpful for maintaining the postoperative anatomic patency of the DCR ostium when a granuloma is located within the ostial base.

In contrast, we found that inner ostium granulomas were associated with poor functional outcomes. Previous studies have suggested that rhinostomy movement (i.e., the amount of lateral movement of the sac wall during blinking) is associated with the functional outcome [22, 23]. The wide range of rhinostomy movement after DCR was associated with preservation of the lacrimal pump function, which consequently resulted in a better functional outcome [24]. Inner granulomas, which probably reflect abnormal inflammation during the wound healing period, might lead to various degrees of fibrosis and cicatrization in the ostium base, yielding poor rhinostomy movement [25]. Thus, inner granulomas are themselves predictive of fibrotic change in the ostium and are associated with a worse functional outcome than other types of ostium granulomas.

Most (46.5%) of the ostium granulomas in this study were located superiorly, which is consistent with previous findings

Table 2 Clinical characteristics of study subjects with and without ostium granulomas

	Granuloma (+) (*n* = 71)	Granuloma (−) (*n* = 112)	*p*
Preoperative assessment			
Age at operation (years)	57.3	58.9	0.702[a]
Sex (male/female), *n*	23/48	19/52	0.462[c]
Past medical history (D/H/A/S), *n*	12/26/3/5	19/36/6/7	0.570[d]
Duration of tearing (months)	30.2	48.6	0.082[b]
Symptoms of chronic discharge, *n* (%)	27 (38%)	31 (27.7%)	0.285[c]
Postoperative assessment			
Mean time to tube removal (months)	2.8	2.7	0.251[a]
Follow-up duration (months)	15.0	14.9	0.989[a]
Surgical outcome, *n* (%)			
Anatomic success	67 (94.4%)	104 (92.9%)	0.731[d]
Function success	61 (85.9%)	98 (87.5%)	0.805[c]
Overall success	61 (85.9%)	94 (83.9%)	0.643[c]

Granuloma (+)/(−): cases with/without ostium granuloma after endoscopic dacryocystorhinostomy

A allergic conjunctivitis, *D* diabetic mellitus, *H* hypertension, *S* sinusitis

[a] Independent *t* test

[b] Mann-Whitney test

[c] Pearson's chi-square test

[d] Fisher's exact test

Table 3 Success rates of endoscopic DCR in previous studies

	Ben et al. [2]	Yung and Hardman-Lea [3]	Nussbaumer et al. [4]	Fayet et al. [5]	Lee et al. [6]	Karimet al. [7]	Do et al. [8]
Cases, *n*	143	191	201	300	986	105	160
Follow-up duration (months)	7	6	12	12	19	6	6
Definition of success	No epiphora	No epiphora	No epiphora	No epiphora and/or lacrimal irrigation	No epiphora	Symptom relief and patent ostium	Endoscopic dye visualization of the nasal opening
Success rate (%)	77	89	90	87	87.2	82.4	90

[6, 14]. This could be explained by residual bare bone after a superior osteotomy impairing wound healing and promoting granuloma formation. This is one of the important reasons to ensure good mucosa-to-mucosa apposition and for covering all exposed bone in DCR in order to promote early wound healing. Delayed and secondary wound healing would result in the development of more inflammation and subsequent cicatrix and granuloma formation [25].

Our study also found that most of the ostium granulomas developed between 1 and 2 months postoperatively (at 46.33 ± 15.9 days; Fig. 3). This finding is consistent with Ali et al. reporting a mean time interval from surgery to the detection of granuloma of 46.9 days (range 7–84 days) [19]. It has been reported that most cases of wound healing, contracture, and scar formation after DCR occur during the first 4 weeks postoperatively [26, 27]. Thus, an ostium granuloma resulting from impairment of the wound healing process will occur after this period. Careful endoscopic observation and monitoring of the development of an ostium granuloma are especially important at 1–2 months after endoscopic DCR. The early detection of granulomas and their appropriate management may aid in inhibiting inflammation and cicatrization of the ostium.

The reported incidence of ostium granuloma formation after DCRs has varied between 20 and 45.7% [7, 20, 28–30], and it was 38.8% in the present study. This variation might be attributable to the use of different surgical techniques and the inclusion of different racial groups. Some studies have used an antifibrotic agent such as intraoperative MMC packing gauze and/or postoperative MMC eyedrops for preventing granuloma formation, whereas such an agent was not used in the present study. The differences could also be due to Koreans having a lower nasal bridge and a higher proportion of cases in which the lacrimal sac fossa consists of the thick frontal process of the maxilla rather than lacrimal bone [31]. These factors require the removal of the hard frontal process of the maxilla and would make the surgery more difficult, resulting in the likelihood of producing a larger amount of bare bone and the subsequent formation of granulomas being higher in Koreans than in Caucasians. In this study, the silicone tube was left in about 3 months. If the prolonged placement of the tube could be the reason for the increased risk for granulomas in our patients, most common type of the granulomas was probably inner. However, only 14.1% of granuloma were inner type and more than half of granuloma were the extra type (57.7%). Thus, we consider that the silicon tube placement for 3 months did not have a significant impact on the postoperative granuloma in our study.

While an ISI may be associated with no serious side effects, one of the present cases had a periorbital bruise after an ISI. We assume that the use of a protocol involving slow injection, small needles (23-gauge needles were used in our case), and not injecting too deeply could help to minimize the incidence of this side effect.

To reduce the postoperative inflammation around lacrimal system, we prescribed the eyedrops containing low-dose steroids and antibiotics for 1 month without any complication. However, surgeons should remember that longer-term use of steroid eyedrops can lead to complications such as cataract, glaucoma, and ocular infection.

This study was subject to several limitations associated with the small number of samples and the study design as an uncontrolled case series. Additionally, the responses to ISIs were not assessed according to the size of ostium granulomas; this relationship could have been evaluated by calculating the granuloma size using image-processing software. Although steroid injection into the ostium granuloma following DCR has been reported previously, standard recommendations are still lacking and the adequate dose and interval of such steroid injections remain controversial. Thus, future controlled trials are required to determine the accurate duration and exact dose of the ISI for use in a guideline on ostium granuloma treatments.

In conclusion, the results of this study suggest that an ISI is a safe, minimally invasive, and effective modality for treating ostium granulomas that do not respond to steroid nasal spray. Specifically, inner ostium granulomas are associated with a worse functional outcome and should be considered for the initiation of early corrective interventions such as ISIs for handling the fibrosis and cicatrization of the ostium during the healing process.

Author contributions HJ Shin designed the study and revised the manuscript. SH Lee and WC Song collected data. A Jo wrote the manuscript.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Woog JJ, Kennedy RH, Custer PL, Kaltreider SA, Meyer DR, Camara JG (2001) Endonasal dacryocystorhinostomy: a report by the American Academy of Ophthalmology. Ophthalmology 108: 2369–2377
2. Ben Simon GJ, Joseph J, Lee S, Schwarcz RM, McCann JD, Goldberg RA (2005) External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in a tertiary referral center. Ophthalmology 112:1463–1468
3. Yung MW, Hardman-Lea S (2002) Analysis of the results of surgical endoscopic dacryocystorhinostomy: effect of the level of obstruction. Br J Ophthalmol 86:792–794
4. Nussbaumer M, Schreiber S, Yung MW (2004) Concomitant nasal procedures in endoscopic dacryocystorhinostomy. J Laryngol Otol 118:267–269
5. Fayet B, Racy E, Assouline M (2004) Complications of standardized endonasal dacryocystorhinostomy with unciformectomy. Ophthalmology 111:837–845
6. Lee TS, Shin HH, Hwang SJ, Baek SH (2007) The results of revisional surgery for the failed endonasal dacryocystorhinostomy. J Korean Ophthalmol Soc 48:186–192
7. Karim R, Ghabrial R, Lynch T, Tang B (2011) A comparison of external and endoscopic endonasal dacryocystorhinostomy for acquired nasolacrimal duct obstruction. Clin Ophthalmol 5:979–989
8. Do JR, Lee H, Baek S, Lee TS, Chang M (2016) Efficacy of postoperative mitomycin-C eye drops on the clinical outcome in endoscopic dacryocystorhinostomy. Graefes Arch Clin Exp Ophthalmol 254:785–790
9. Saratziotis A, Emanuelli E, Gouveris H, Tsironi E, Fountas K (2014) Endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction: long-term results in 91 procedures. Rhinology 52:413–418
10. Li EY, Cheng AC, Wong AC, Sze AM, Yuen HK (2016) Safety and efficacy of adjunctive intranasal mitomycin C and triamcinolone in endonasal endoscopic dacryocystorhinostomy. Int Ophthalmol 36: 105–110
11. Zenk J, Karatzanis AD, Psychogios G, Franzke K, Koch M, Hornung J, Velegrakis GA, Iro H (2009) Long-term results of endonasal dacryocystorhinostomy. Eur Arch Otorhinolaryngol 266:1733–1738
12. Mak ST, Io IY, Wong AC (2013) Prognostic factors for outcome of endoscopic dacryocystorhinostomy in patients with primary acquired nasolacrimal duct obstruction. Grafes Arch Clin Exp Ophthalmol 251:1361–1367
13. Woog JJ (2004) Manual of endoscopic lacrimal surgery and orbital surgery. Butterworth Heinmann, Philadelphia, pp 111
14. Zeldovich A, Ghabrial R (2009) Revision endoscopic dacryocystorhinostomy with betamethasone injection under assisted local anaesthetic. Orbit 28:328–331
15. Lee BJ, Nelson CC, Lewis CD, Perry JD (2012) External dacryocystorhinostomy outcomes in sarcoidosis patients. Ophthal Plast Reconstr Surg 28:47–49
16. Ben Simon GJ, Huang L, Nakra T, Schwarcz RM, McCann JD, Goldberg RA (2005) Intralesional triamcinolone acetonide injection for primary and recurrent chalazia: is it really effective? Ophthalmology 112:913–917
17. Mabry RL (1994) Intranasal steroids in rhinology: the changing role of intraturbinal injection. Ear Nose Throat J 73:242–246
18. Kırıs M, Muderris T, Yalçıner G, Bercin S, Sevil E, Gul F (2016) Intrapolyp steroid injection for nasal polyposis: randomized trial of safety and efficacy. Laryngoscope 126:1730–1735
19. Ali MJ, Wormald PJ, Psaltis AJ (2015) The dacryocystorhinostomy ostium granulomas: classification, indications for treatment, management modalities and outcomes. Orbit 34:146–151
20. Park J, Kim H (2016) Office-based endoscopic revision using a microdebrider for failed endoscopic dacryocystorhinostomy. Eur Arch Otorhinolaryngol 273:4329–4334
21. Moore WM, Bentley CR, Olver JM (2002) Functional and anatomic results after two type of endoscopic endonasal dacryocystorhinostomy: surgical and holmium laser. Ophthalmology 109:1575–1582

22. Hammoudi DS, Tucker NA (2011) Factors associated with outcome of endonasal dacryocystorhinostomy. Ophthal Plast Reconstr Surg 27:266–269
23. Kakizaki H, Takahashi Y, Miyazaki H, Nakamura Y (2013) Movement of internal canalicular orifice in association with blinking: direct observation after dacryocystorhinostomy. Am J Ophthalmol 156:1051–1055
24. Shin HJ, Woo KI, Kim YD (2017) Factors associated with rhinostomy shape after endoscopic dacryocystorhinostomy. Clin Otolaryngol 42:550–556
25. Onerci M, Orhan M, Ogretmenoğlu O, Irkeç M (2000) Long-term results and reasons for failure of intranasal endoscopic dacryocystorhinostomy. Acta Otolaryngol 120:319–322
26. Mann BS, Wormald PJ (2006) Endoscopic assessment of the dacryocystorhinostomy ostium after endoscopic surgery. Laryngoscope 116:1172–1174
27. Chan W, Selva D (2013) Ostium shrinkage after endoscopic dacryocystorhinostomy. Ophthalmology 120:1693–1696
28. Jordan DR, Brownstein S, Lee-Wing M, Ashenhurst M (2001) Pyogenic granuloma following oculoplastic procedures: an imbalance in angiogenesis regulation? Can J Ophthalmol 36:260–268
29. Baek JS, Jeong SH, Lee JH, Choi HS, Kim SJ, Jang JW (2017) Cause and management of patients with failed endonasal dacryocystorhinostomy. Clin Exp Otorhinolaryngol 10:85–90
30. Park JD, Kim YI, Shin SG (1998) The factors related to surgical success rate of endonasal dacryocystorhinostomy. J Korean Ophthalmol Soc 12:2848–2553
31. Woo KI, Maeng HS, Kim YD (2011) Characteristics of intranasal structures for endonasal dacryocystorhinostomy in Asians. Am J Ophthalmol 152:491–498