• Clinical Research •

# Efficacy of adjuvant mitomycin-C and triamcinolone-impregnated nasal packing for endoscopic dacryocystorhinostomy

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Received: 2023-07-16 Accepted: 2023-09-28

## Abstract

● **AIM:** To compare the success rate and complications of adjuvant use of mitomycin C and triamcinolone-impregnated biodegradable nasal packing (TABP) in endoscopic dacryocystorhinostomy (DCR). And to evaluate the efficacy of combining intraoperative mitomycin C and TABP for endoscopic DCR.

● **METHODS:** A total of 198 eyes of 148 patients who underwent endoscopic DCR for acquired nasolacrimal duct obstruction were retrospectively analysed. The patients were randomly divided into three groups: Group A included patients treated without intraoperative mitomycin C but with TABP, Group B included patients treated without triamcinolone but with intraoperative mitomycin C and normal saline-impregnated nasal packing, and Group C included patients treated with intraoperative mitomycin C and TABP.

● **RESULTS:** The results revealed no significant difference in the overall success rates between Groups A (86.8%) and B (89.2%; *P*=0.377). However, Group C (97.5%) showed a significantly higher overall success rate than Groups A and B. The incidence of granulomas was significantly lower in group C (5%) than in Groups A (20.8%) and B (15.2%; *P*=0.009). Other complications, such as crust, synechiae, and revision surgery, did not differ significantly among the three groups.

● **CONCLUSION:** The combination of intraoperative mitomycin C and TABP effectively prevents granulomas and enhances surgical success rate. Additionally, there is no statistically significant difference observed between the use of mitomycin C or TABP alone.

● **KEYWORDS:** dacryocystorhinostomy; endoscopic; mitomycin C; triamcinolone; biodegradable

**DOI:10.18240/ijo.2024.03.09**

**Citation:** Kim SY, Chambers CB, Ahn JH. Efficacy of adjuvant mitomycin-C and triamcinolone-impregnated nasal packing for endoscopic dacryocystorhinostomy. *Int J Ophthalmol* 2024;17(3):480-484

## INTRODUCTION

Endonasal dacryocystorhinostomy (DCR) is a commonly utilized nasal approach to address blockages in the system of nasolacrimal drainage, generally exhibiting a promising outcome. Nevertheless, the rates of unsuccessful outcomes vary between 4% and 13%[1-3]. Surgical failures primarily stem from scarring and the healing and sealing of the osteotomy site due to cicatrization[2-3]. The use of antifibrotic agents such as mitomycin C can potentially improve success rates by preventing cicatrix formation and scarring through their wound-modifying effects[4-7]. A Meta-analysis on mitomycin C's efficacy in both external and endoscopic DCR has confirmed its safety and effectiveness in reducing osteotomy closure rates[5-6]. Additionally, triamcinolone-impregnated nasal packing has been reported to decrease granulation and enhance the success rate in endoscopic DCR[7-8]. Triamcinolone acetonide, a synthetic corticosteroid, is known to inhibit inflammatory responses and fibrosis during the early wound-healing process, potentially minimizing scar formation. However, there is a lack of direct comparisons between the outcomes of using either adjunctive mitomycin C or steroid-impregnated nasal packing alone in endoscopic DCR. Therefore, this study aims to analyze difference regarding the rates of success and potential complications in

surgical procedures, specifically endoscopic DCR with the incorporation of mitomycin C as an adjunct and triamcinolone-impregnated nasal packing. Additionally, we assess the effectiveness of combining adjunctive mitomycin C with triamcinolone-impregnated nasal packing in endoscopic DCR.

## SUBJECTS AND METHODS

**Ethical Approval** The procedures adhered to the principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board of Pusan National University Yangsan Hospital (Approval No. 05-2021-073). All patients provided written informed consent.

**Study Design** We conducted a retrospective examination of patients who underwent endoscopic DCR procedure for cases of primary acquired obstruction in the nasolacrimal duct between April 2013 and December 2020. All surgeries of the patients were performed by a single surgeon (Ahn JH).

Patients meeting following criteria were included: primary nasolacrimal duct obstruction, age over 18y, absence of nasal or other systemic conditions affecting the nasal mucosa, no eyelid or eyelash anomalies, and availability for at least 6-month of follow-up. Exclusion criteria included: secondary acquired nasolacrimal duct obstruction due to trauma, head and neck tumors, previous failed DCR, stenosis of both superior and inferior canaliculi, common canaliculus obstruction, and less than 6mo period for the follow-up.

Patients were assigned randomly to three groups: Group A received treatment with triamcinolone-impregnated nasal packing without intraoperative mitomycin C, Group B underwent treatment with intraoperative mitomycin C without triamcinolone-impregnated nasal packing, and Group C received treatment with both intraoperative mitomycin C and triamcinolone-impregnated nasal packing.

**Surgical Technique and Postoperative Care** Every surgical procedure was performed with the use of general anesthesia. The position and size of the lacrimal sac were verified by inserting 23-gauge disposable vitrectomy illuminator. The mucous membrane in the nasal region along the lacrimal crest was cut and eliminated utilizing monopolar cautery. The lacrimal and maxillary bones were excised using a Kerrison punch. A powered microdrill was utilized to enlarge the osteotomy site, establishing a bony opening within the nasal cavity with a minimum diameter of 10 mm. Following tenting of the lacrimal sac with a Bowman probe, a sickle knife was employed to make an incision in the medial wall of the exposed lacrimal sac. Subsequently, the lacrimal sac was carefully extracted using ethmoid forceps.

In cases where intraoperative mitomycin C was applied, a neurosurgical cottonoid saturated with mitomycin C (0.4 mg/mL) was inserted into the osteotomy site for a duration of 5min. After removing the cottonoid, the osteotomy site underwent irrigation with normal saline lasted for a minimum of 1min. In Group A, no intraoperative application of mitomycin C was performed. Subsequently, bicanalicular intubation was carried out. NasoPore Standard (Polyganics, Groningen, Netherlands) nasal packing impregnated with triamcinolone was placed into the osteotomy sites in groups A and C, while normal saline-impregnated NasoPore nasal packing was used in Group B.

Postoperatively, all patients in the three groups were prescribed topical antibiotics (0.3% levofloxacin) and steroid (0.1% fluorometholone) eye drops 4 times daily for a duration of 3mo, excluding steroid nasal spray. Follow-ups were scheduled at 1wk, 1, 3, and 6mo after surgery. NasoPore was naturally absorbed within 5wk without requiring nasal cavity removal, and the silicone tube that was implanted was taken out 3mo post-operation.

**Outcome Assessment** The evaluation of surgical outcomes took place six months post-surgery, categorizing success into anatomical and functional aspects. The confirmation of anatomical success involved using endoscopy to observe the visualization of dye at the nasal opening of the anastomosis and assessing unobstructed fluid flow during lacrimal irrigation without any backward flow or regurgitation. Functional success was outlined by either complete resolution (Munk score grade 0) or improvement (Munk score grade 1) of epiphora, assessed through fluorescein dye visualization at the ostium and disappearance test grades of 0 or 1[9]. Subsequent routine postoperative follow-ups included the examination of complications such as granuloma formation, crusts, synechia, and infections using endoscopy.

**Statistical Analysis** Statistical analyses were performed using IBM SPSS Statistics for Windows (version 24.0; IBM Corp., Armonk, NY, USA), with statistical significance set at $P<0.05$. Numerical variables were analyzed using Kruskal-Wallis tests, while nominal scale variables underwent analysis through Fisher's exact and Chi-square tests.

## RESULTS

A total of 198 eyes of 148 participants were enrolled in this study. Among the patients, 72 eyes of 52 patients (36.3%) were included in Group A, 46 eyes of 36 patients (23.2%) in Group B, and 80 eyes of 60 patients (40.4%) in Group C. The mean age of participants was 60.4±12.7y and there were 149 eyes (75.3%) in women and 49 eyes (24.7%) in men. This study composed of 88 right (54.2%) and 110 left eyes (45.8%). The mean time to tube removal was 3.86±0.6mo, and the follow-up period was 7.73±1.2mo. Among the three groups, there were no significant differences in age, sex ratio, laterality, tube removal time, or follow-up period (Table 1).

The anatomical success rates of the Group A, B, and C were 88.9%, 91.3%, and 98.7%, respectively. Group C exhibited a significantly higher success rate compared to groups A and

**Table 1 Patient demographics and characteristics**

| Variables | Group A (no mitomycin C +triamcinolone) | Group B (mitomycin C +no triamcinolone) | Group C (mitomycin C + triamcinolone) | *P* |
|---|---|---|---|---|
| Eyes (patients) | 72 (52) | 46 (36) | 80 (60) | - |
| Mean ages (y) | 57.3±13.1 | 63.3±11.4 | 60.3±14.2 | 0.160[a] |
| Sex (No. of patients) | | | | 0.104[b] |
| Male/female | 9/43 | 13/23 | 12/48 | |
| Laterality (No. of eyes) | | | | 0.748[b] |
| Right/left | 32/40 | 22/24 | 34/46 | |
| Mean time to tube removal (mo) | 4.1±0.8 | 3.7±0.6 | 3.8±0.4 | 0.630[a] |
| Follow-up periods after surgery (mo) | 7.8±1.3 | 7.5±1.1 | 7.9±1.2 | 0.092[a] |

*P*<0.05 was considered statistically significant. [a]Comparison among groups using the Kruskal-Wallis test, [b]Comparison among the groups using Fisher's exact test.

**Table 2 Comparison of anatomical and functional success among the three groups** *n* (%)

| Results | Group A (no mitomycin C+triamcinolone) *n*=72 | Group B (mitomycin C+no triamcinolone) *n*=46 | Group C (mitomycin C+triamcinolone) *n*=80 | *P*[a] |
|---|---|---|---|---|
| Anatomical | | | | 0.020 |
| Success | 64 (88.9) | 42 (91.3) | 79 (98.7) | |
| Failure | 8 (11.1) | 4 (8.7) | 1 (1.3) | |
| Functional | | | | 0.036 |
| Success | 61 (84.7) | 40 (87.0) | 77 (96.2) | |
| Failure | 11 (15.3) | 6 (13.0) | 3 (3.8) | |

*P*<0.05 was considered statistically significant. [a]Comparison among groups using Fisher's exact test.

B (*P*=0.020, Fisher's exact test). The Group C also exhibited significantly higher functional success rate compared to groups A and B (*P*=0.036, Fisher's exact test). However, in the anatomical and functional success rates between groups A and B showed no significant differences (*P*=0.342 and *P*=0.412, respectively, Fisher's exact test; Table 2).

Granulomas occurred in 26 (22.2%) of the 198 eyes, including 15 (20.8%) in Group A, 7 (15.2%) in Group B, and 4 (5.0%) in Group C. The incidence rate was significantly lower in Group C than in Groups A and B (*P*=0.009, Fisher's exact test). Nevertheless, the incidence rates between groups A and B showed no statistically significant difference. (*P*=0.251, Chi-square test). The success rates were assessed based on the presence of granulation. The anatomical and functional success rates without granulation were higher than those with granulation (94.8% *vs* 84.6%, *P*=0.012; 94.1% *vs* 61.5%, *P*=0.000, Fisher's exact test; Table 3).

The incidence rates of crust, synechiae, and revision surgery were lower in Group C than in Groups A and B; however, the differences showed no statistical significance (*P*=0.166, *P*=0.072, and *P*=0.219, respectively, according to Fisher's exact test). No patients developed infections after surgery (Table 4).

**Table 3 Comparison of surgical results according to granulation occurrence** *n* (%)

| Results | Granulation occurrence (*n*=26) | Without granulation occurrence (*n*=172) | *P*[a] |
|---|---|---|---|
| Anatomical | | | 0.012 |
| Success | 22 (84.6) | 163 (94.8) | |
| Failure | 4 (15.4) | 9 (5.2) | |
| Functional | | | 0.000 |
| Success | 16 (61.5) | 162 (94.1) | |
| Failure | 10 (38.5) | 10 (5.9) | |

*P*<0.05 was considered statistically significant. [a]Comparison between groups using Fisher's exact test.

## DISCUSSION

Numerous techniques have been documented to forestall the cicatricial closure of the ostium, encompassing measures like sufficiently sized osteotomies[3], uncinectomy[10], suturing the lacrimal sac to nasal mucosa[11], employing mitomycin C as an adjunct[5], silicone tube intubation[12-13], utilizing synthetic polyurethane foam as nasal packing[9,14], lacrimal irrigation in the postoperative period[15], and the application of media such as sodium hyaluronate to diminish the formation of postoperative granulomas[16]. Among these approaches, the supplementary use of mitomycin C is widely acknowledged and favored for its effectiveness in preventing cicatrix formation at the osteotomy site during the wound healing process[17].

Various adjunctive methods of mitomycin C application have been reported, including intraoperative application, topical postoperative eye drops, circumostial injections, or multiple postoperative applications with intraoperative use[18-19]. However, the use of topical postoperative eye drops may pose a risk

**Table 4 Comparison of postoperative complications among the three groups** *n* (%)

| Causes | Group A (no mitomycin C +triamcinolone) *n*=72 | Group B (mitomycin C +no triamcinolone) *n*=46 | Group C (mitomycin C +triamcinolone) *n*=80 | *P*[a] |
|---|---|---|---|---|
| Granuloma | 15 (20.8) | 7 (15.2) | 4 (5.0) | 0.009 |
| Crust | 10 (13.9) | 7 (15.2) | 5 (6.3) | 0.166 |
| Synechia | 5 (6.9) | 4 (8.7) | 3 (3.8) | 0.072 |
| Revision surgery | 4 (5.6) | 3 (6.5) | 1 (1.3) | 0.219 |

*P*<0.05 was considered statistically significant. [a]Comparison among groups using Fisher's exact test.

of corneal epithelial erosion if it persists for more than 3d. Additionally, the direct circumostial mitomycin C injections into the nasal mucosa should be studied at the cellular level. Instead of topical mitomycin C, considering the use of mitomycin C on the osteotomy site during surgery is advisable to minimize the formation of granulomas in the postoperative period.

Triamcinolone acetonide is a synthetic corticosteroid known to suppress inflammatory responses and fibrosis during the initial stages of the wound healing process, reducing scar formation[20]. Recently, Kang *et al*[8] reported the efficacy of triamcinolone-impregnated nasal packing in endoscopic DCR combined with postoperative 0.03% mitomycin C eye drops, with an overall success and granulation rate of 96.0% and 10.0%, respectively. However, they did not compare the clinical outcomes between the single use of adjunctive mitomycin C and triamcinolone-impregnated nasal packing.

In our study, we administered intraoperative adjunctive mitomycin C at a concentration of 0.04% for 5min. Our hypothesis was that compared to postoperative mitomycin C delivered through topical eye drops, intraoperative application would ensure comprehensive coverage of the entire ostium site margin in endoscopic DCR. The utilization of mitomycin C during surgery along with nasal packing containing triamcinolone led to a surgical success rate of 98.7% and a granuloma occurrence rate of 5%. These clinical outcomes surpassed those reported in prior studies. However, there was no statistically discernible difference in success rates or granuloma incidence between the sole use of adjunctive mitomycin C and triamcinolone-impregnated nasal packing. Success rates were significantly lower in cases with granulation compared to those without, but the presence of granulation did not impact the overall condition of surgical failure. Remarkably, certain patients who achieved surgical success also encountered granulation, while others with surgical failure did not (Table 3).

Within the framework of endoscopic sinus surgery, the positive effects of biodegradable nasal dressings infused with steroids on wound healing have been documented, including reduced scarring, edema, crusting, and synechiae post-surgery. The intranasal application of triamcinolone-impregnated absorbable nasal packing, designed to gradually dissolve over 2 to 3wk, facilitates sustained corticosteroid release, contributing to decreased scarring and granuloma formation at the nasal ostial opening.

However, our study has some limitations. First, we did not assess the size, position, or duration of ostial granuloma occurrences after DCR. We assessed only whether granuloma formation was present or absent and did not investigate the extent of granuloma formation or the specific timing of its occurrence. Second, the positive effects of absorbable packing materials on granuloma tissue formation were not considered. Nasopores are thought to promote quick reepithelialization, hinder excessive secondary scarring, and prevent undue fibrosis[14], and expedite wound healing by creating a moist dressing environment, potentially reducing granuloma formation. Third, the impact of steroid eye drops on DCR outcomes was not excluded. The effect of steroid action on the wound-healing process during topical application could not be ruled out. Fourth, we did not evaluate the shape of the rhinostomy and characteristics of the lacrimal sac, including dimensions, thickness, and mobility. These factors could vary among patients and potentially affect surgical success rates and complications.

In conclusion, there were insignificant differences in success rates and granuloma development between single use of adjuvant mitomycin C and steroid-impregnated nasal packing. However, combining intraoperative mitomycin C and steroid-impregnated absorbable nasal packing effectively prevented granulomas and enhanced the surgical success rate. Further examinations are required to investigate the duration and consistency and of steroid delivery. More research is needed to compare the surgical outcomes between non-absorbable and absorbable nasal packing materials.

## ACKNOWLEDGEMENTS

**Authors' contributions:** All authors participated in formulating and designing the study. Kim SY and Ahn JH conducted material preparation, data collection, and analysis using their respective software. Kim SY wrote the first draft of the manuscript, and Ahn JH and Chambers CB revised the manuscript. All authors commented on the previous manuscript versions and read and approved the final version.

**Conflicts of Interest: Kim SY,** None; **Chambers CB,** None; **Ahn JH,** None.

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