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Original Research Article

Effect of mitomycin C on the outcome of transcanalicular laser dacryocystorhinostomy

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Abstract

Aim and Objective: This study aimed to evaluate the efficacy of Mitomycin C (MMC) as an adjunctive therapy in transcanalicular laser-assisted dacryocystorhinostomy (DCR) for the management of nasolacrimal duct obstruction (NLDO), comparing outcomes with procedures performed without MMC.
Introduction: Nasolacrimal duct obstruction (NLDO) is a common condition often requiring surgical intervention, with dacryocystorhinostomy (DCR) being the gold standard treatment. Transcanalicular laser-assisted DCR has emerged as a minimally invasive alternative, though postoperative fibrosis and ostium closure remain significant challenges. Mitomycin C (MMC), an antiproliferative agent, has shown potential in improving surgical outcomes by reducing scar tissue formation.
Materials and Methods: A prospective, comparative analysis was conducted on 189 patients who underwent transcanalicular laser DCR between 2022 and 2024 in Vision Eye Hospital, Dhaka, Bangladesh. Patients were divided into two groups: 103 received intraoperative MMC (0.5 mg/mL applied for 5 minutes), while 86 underwent surgery without MMC. All procedures were performed under local anesthesia using a diode laser, with bi-canalicular silicone stents placed and removed after one month. Success was defined as the absence of epiphora and patent lacrimal irrigation during follow-up (up to one year). Statistical analysis was performed using SPSS version 26, with $p<0.05$ considered significant.
Result: The success rate was significantly higher in the MMC group (91.3%, 94/103) compared to the non-MMC group (80.2%, 69/86; $p=0.03$). Postoperative complications, such as fibrosis and granulation tissue formation, were less frequent in the MMC group. Demographic characteristics (age, gender) were comparable between groups ($p>0.05$).
Conclusion: Adjunctive use of MMC in transcanalicular laser DCR significantly improves surgical success rates by reducing postoperative scarring. In light of the study outcome we recommend MMC to be used as an adjunctive therapy in transcanalicular laser-assisted DCR surgery for better success rate. Further prospective studies with longer follow-up are warranted to validate these results.

Keywords: Dacryocystorhinostomy, Mitomycin C, Transcanalicular laser DCR, Nasolacrimal duct obstruction.

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1. Introduction

Nasolacrimal duct obstruction (NLDO) with symptomatic epiphora is a common disorder that presents to the ophthalmologist.[1] NLDO is a prevalent condition that often leads to chronic dacryocystitis. Surgical intervention called Dacryocystorhinostomy (DCR) is the main stay of effective management.[2,3] External DCR remains the gold standard for treating NLDO, traditionally offering the highest success rates. With the advent of minimally invasive techniques, transcanalicular laser-assisted DCR, has provided an alternative approach to external DCR that reduces trauma and postoperative morbidity. The success rate of transcanalicular laser-assisted DCR is almost comparable to that of external

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DCR.[3] Recent cohort study conducted by Różycki et al. (2024), have further validated the success rate and efficacy of laser-assisted techniques, highlighting their growing adoption in clinical practice.[4] Despite these advancements, the outcome of transcanalicular laser-assisted DCR surgery largely depend on postoperative complications like fibrosis, granulation tissue formation and adhesion which causes closure of the opening (called the ostium) created by the laser. And these remain the significant challenges that can compromise outcomes or the success rate of the surgery.[5]

To prevent these postoperative complications the use of Mitomycin C (MMC) has gained much popularity in recent years. Mitomycin C (MMC), derived from *Streptomyces caespitosus*, is an alkylating antibiotic. It is an antiproliferative agent that inhibits fibroblast activity and collagen synthesis, by inhibiting DNA-dependent RNA synthesis and can suppress cellular proliferation in any period of the cell cycle. The probable benefit of MMC as a surgical adjuvant is thought to be related to its potent inhibition of fibroblast proliferation. Intraoperative use of MMC in lacrimal drainage surgery can minimize postoperative fibrosis and granulations, thereby achieving a bigger postoperative ostium.[6,7,8,9]

Studies over the past decade have demonstrated mixed results regarding the efficacy of MMC in DCR procedures [6]. Some authors have reported a higher success rate in patients treated with MMC, though the difference was not statistically significant, and some authors found no significant benefit from intraoperative MMC use in transcanalicular diode laser DCR. There are others studies conducted that found clear reduction in fibrosis when MMC was used and a statistically significant improvement in success rates with MMC, even without the use of silicone intubation.[7,8,9,10] These disparities of results could be due to difference in sample size, types of study conducted and variation in surgical technique.

Given the ongoing debate and the need for larger, well-designed studies with a specific surgical technique to clarify the role of MMC in transcanalicular laser-assisted DCR, this prospective, interventional comparative study aims to evaluate the outcomes of transcanalicular laser DCR with and without the adjunctive use of MMC.

2. Materials and Methods

2.1. Study design and population

This study was designed as a prospective, comparative, non-randomized, interventional study to evaluate the outcomes of transcanalicular endoscopic laser-assisted dacryocystorhinostomy (DCR) with and without the adjunctive use of Mitomycin C (MMC). The study population consisted of 189 patients diagnosed as patients of Chronic dacryocystitis due to nasolacrimal duct obstruction (NLDO) who underwent transcanalicular laser DCR between 2022 and 2024 at Vision Eye Hospital, Dhaka, Bangladesh that were followed-up up to 1 year. The patients were divided into two groups: 103 patients who underwent the procedure with the use of MMC and 86 patients who underwent the procedure without the use of MMC. The inclusion criteria were patients with primary NLDO, while exclusion criteria included previous lacrimal surgery, traumatic NLDO, or systemic conditions affecting wound healing.[3,5]

2.2. Surgical procedure

All procedures were performed under local anesthesia by the same two experienced surgeons to ensure consistency in technique. To make the patient pain free during surgery and reduce bleeding intra-nasal anesthesia and vasoconstriction were achieved by packing the nasal cavity with cotton sponges soaked in a mixture of 1:100,000 epinephrine and 4% lidocaine. A diode laser with a power range of 8–12 W, pulse time of 350–500 ms, and pause duration of 350–500 ms between pulses was used for the procedure. The upper and lower lacrimal puncta and canaliculi were dilated, and the laser fiber was inserted through the superior canaliculus until it reached the lacrimal sac wall. An endoscope was used to visualize the pilot laser light beam in the nasal passage, and the osteotomy site was broadened to at least 5 mm in diameter.[7,9]

In the MMC group, a cotton ball saturated with 0.1 mL of a 0.5 mg/mL MMC solution was applied to the osteotomy site for 5 minutes, followed by irrigation with saline. All patients were intubated with a bi-canalicular silicone tube (stent), which was removed after one month. Postoperative care included antibiotic-steroid eye drops and nasal decongestants four times daily for two weeks, along with systemic antibiotics for one week.[7]

2.3. Follow-up and outcome measures

Patients were followed up on the first day, first week, first month, and third month postoperatively, and then at three-month intervals up to one year. At each visit, the patency of the lacrimal drainage system was evaluated using lacrimal irrigation and endoscopic examination. Surgical success was defined as the absence of epiphora and a patent lacrimal system on irrigation. Failure was defined as persistent epiphora or obstruction of the lacrimal system.[11]

2.3. Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26 software. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. The chi-square test and Student's t-test were used to compare outcomes between the two groups, with a p-value <0.05 considered statistically significant.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional review board (IRB) of Vision Eye Hospital. After the IRB approval on November 2022, informed consent was obtained from all participants prior to their inclusion in the study.

3. Results

The study included a total of 189 patients diagnosed with nasolacrimal duct obstruction (NLDO) who underwent transcanalicular endoscopic laser-assisted dacryocystorhinostomy (DCR). Of these, 103 patients received adjunctive Mitomycin C (MMC) during the procedure, while 86 patients underwent the surgery without MMC. The demographic characteristics of the two groups were comparable, with no significant differences in age or gender distribution (Table 1). The mean age of patients in the MMC group was 45.3 ± 8.4 years, compared to 46.9 ± 9.3 years in the non-MMC group (p=0.22). Gender distribution was also similar, with 49 males and 54 females in the MMC group, and 45 males and 41 females in the non-MMC group (p=0.52).

Table 1: Comparison of demographic characteristics of subjects of two groups (n=189).

Characteristics	TCL EN-DCR with MMC	TCL EN-DCR without MMC	P value
Age	45.3±8.4	46.9±9.3	0.22
Gender			
Male	49	45	0.52
Female	54	41	

The primary outcome measure was the success rate of the procedure, defined as the absence of epiphora and a patent lacrimal system on irrigation during follow-ups up to 1 year. The success rate in the MMC group was significantly higher (91.3%, 94/103) compared to the non-MMC group (80.2%, 69/86), with a p-value of 0.03, indicating statistical significance (Table 2). Conversely, the failure rate was higher in the non-MMC group (19.8%, 17/86) compared to the MMC group (8.7%, 9/103). These findings suggest that the use of MMC as an adjunctive therapy in transcanalicular laser DCR significantly improves surgical outcomes.

Table 2: Comparison of the outcome of transcanalicular endoscopic laser DCR with and without the use of MMC (n=189)

Outcome	TCL EN-DCR with MMC (n=103)	TCL EN-DCR without MMC (n=86)	P value
Success	94	69	0.03
Failure	9	17	

4. Discussion

The findings of this study demonstrate that the adjunctive use of Mitomycin C (MMC) in transcanalicular laser-assisted dacryocystorhinostomy (DCR) surgery significantly improves surgical success rates compared to procedures performed without MMC. In our cohort of 189 patients, the success rate in the MMC group was 91.3%, compared to 80.2% in the non-MMC group, with the difference being statistically significant (p=0.03). These results align with previous studies that have explored the role of MMC in reducing postoperative fibrosis and granulation tissue formation, which are major contributors to DCR failure.[3,5] The histopathological study by Kim et al. (2021) further supports these findings, demonstrating that MMC directly modulates wound healing pathways to reduce collagen deposition and scar formation at the osteotomy site.[12]

The mechanism by which MMC enhances surgical outcomes lies in its antiproliferative properties. MMC inhibits fibroblast activity and collagen synthesis, thereby reducing scar tissue formation at the osteotomy site (the opening made by laser through the lacrimal sac, lacrimal bone and nasal mucosa) and maintaining a patent lacrimal drainage system for tear to drain through the lacrimal canaliculi and sac into the nasal cavity.[7] This is particularly relevant in transcanalicular laser DCR, where the minimally invasive nature of the procedure can sometimes result in smaller osteotomy sites that are more prone to closure due to fibrosis. Our findings are consistent with those of Kar et al. (2015), who reported higher success rates in patients treated with MMC, although their study did not reach statistical significance, possibly due to a smaller sample size.[7] Yildirim et al. (2016) also reported comparable long-term success rates with MMC in laser DCR, reinforcing its sustained benefits.[13] In contrast, Ozsutcu et al. (2017) found no significant benefit from intraoperative MMC use in transcanalicular diode laser DCR, attributing this to differences in surgical technique and patient selection.[9] However, our larger study population and standardized surgical approach provide stronger evidence supporting the efficacy of MMC in this context.

The role of silicone intubation in DCR outcomes has also been a topic of debate. In our study, all patients received bi-canalicular silicone tube (stents), which were removed after one month. Özkiriş and Özkiriş (2012), who conducted a similar comparative study among patients undergoing endoscopic dacryocystorhinostomy. Out of the 54 patients that were included in that study 28 received MMC as adjunctive during surgery and 26 did not receive MMC. The success rate was much higher in the MMC group than the non-MMC group and the difference in success rate was statistically significant. Silicon tube was not used in any of the group attributing the difference in success rate to the use of MMC.[10] Lee et al. (2020) further contextualized this debate in their meta-analysis, noting that while stents may aid in maintaining patency, adjunctive therapies like MMC significantly influence long-term success.[14] However, the

combination of MMC and silicone intubation appears to offer synergistic benefits, as evidenced by the high success rates in our MMC group. Recent studies by Ali et al. (2018) and Deka et al. (2019) have also highlighted the importance of combining MMC with silicone stents to achieve optimal outcomes in endoscopic DCR, further supporting our findings.[15,16.]

In terms of limitation of our study, the non-randomized nature of the sampling technique, may introduce selection bias. Additionally, the follow-up period of one year, while sufficient to assess short- to medium-term outcomes, may not capture late failures due to delayed fibrosis or other complications. Future prospective, randomized controlled trials with longer follow-up periods are needed to further validate these findings and explore the long-term efficacy of MMC in transcanalicular laser DCR. Work by Jin et al. (2006) and Cheng et al. (2013) has emphasized the need for standardized protocols and longer follow-up periods to better understand the role of MMC in lacrimal surgery.[17,18]

5. Conclusion

Our study provides strong evidence that the use of MMC as an adjunctive therapy reduce postoperative failure in transcanalicular laser-assisted DCR surgery by reducing fibrosis, adhesion and granulation tissue formation. The significant difference in outcomes between the MMC and non-MMC groups highlights the importance of incorporating antiproliferative agents into the surgical management of nasolacrimal duct obstruction.

6. Ethical Committee Approval

The study was approved by the institutional Review Board (IRB) of Vision Eye Hospital, 229 Green Road, Dhaka-1205, Bangladesh.

7. Recommendation

In light of the study outcome we recommend 0.1 mL of a 0.5 mg/mL MMC solution to be applied to the osteotomy site for 5 minutes as an adjunctive therapy in transcanalicular laser-assisted DCR surgery for better success rate.

8. Conflict of Interest

The authors declare that they have no potential conflicts of interest relevant to this article.

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