Archives of
Ophtalmological Research

Original Article

DOI: 10.51271/AOR-0035

Comparative effectiveness of monocanalicular and bicanalicular silicone intubation in congenital nasolacrimal duct obstruction

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Cite this article: Oyur G, Savur F, Kumantaş E. Comparative effectiveness of monocanalicular and bicanalicular silicone intubation in congenital nasolacrimal duct obstruction. *Arch Ophthalmol Res.* 2025;2(3):48-52.

Received: 03/06/2025 ◆ **Accepted:** 23/07/2025 ◆ **Published:** 28/07/2025

ABSTRACT

Aims: This study aimed to evaluate and compare the clinical success and outcomes of monocanalicular (MCI) versus bicanalicular silicone intubation (BCI) in pediatric patients with congenital nasolacrimal duct obstruction (CNLDO).

Methods: A retrospective, comparative study was conducted on 41 eyes of 41 children diagnosed with CNLDO, treated with either monocanalicular silicone intubation (MCI, n=16) or bicanalicular silicone intubation (BCI, n=25). All procedures were performed by 2 oculoplastic surgeons. Tube removal was planned for the 3rd postoperative month. Treatment success was defined as a fluorescein disappearance test of 0 and a Munk score of 0-1, 3 months after tube removal.

Results: Forty-one eyes of 41 patients were analysed in 2 groups as MCI (n=16) and BCI (n=25). The mean age was 43.1±17.9 months (between 24 months and 72 months). Twenty-five (61%) of the patients were females and 16 (39%) were males. Twenty-one (51.2%) of the patients were right eyes and 20 (47.8%) were left eyes. Treatment success was achieved in 93.7% of the MCI group and 88% of the BCI group. There was no statistically significant difference between the MCI and BCI groups in terms of age, gender distribution, and laterality (p>0.05)

Conclusion: Monocanalicular and bicanalicular intubation showed similar success rates in treating CNLDO. However, monocanalicular intubation provided greater tube stability and technical simplicity, making it a practical option in pediatric cases.

Keywords: Congenital nasolacrimal duct obstruction; lacrimal drainage system; silicone tube intubation

INTRODUCTION

Congenital nasolacrimal duct obstruction (CNLDO) is the leading cause of epiphora in childhood.[1] The spontaneous cure rate in the first year of life ranges from 62.8 to 95.0%.[2,3] While the management of CNLDO in children younger than one year is usually hydrostatic massage and treatment with topical antibiotics.[4,5] probing is the preferred method with high success rates in cases of unresolved epiphora in children older than one year.[6,7] However, the success rate of probing decreases with advancing age.[8] Nasolacrimal silicone intubation has been recommended as the primary procedure after failed probing and in children older than 24 months.[9] Bicanalicular intubation (BCI) and monocanalicular intubation (MCI) methods are used for this purpose. In recent years, a number of studies examined the outcomes of these 2 intubations in different age group.[10-12] The aim of this study was to compare the success rate and complications of MCI and BCI in children with CNLDO between 2 and 6 years of age.

METHODS

Study Design

The study, which was conducted in accordance with the principles of the Declaration of Helsinki and Good Clinical Practices, was approved by the Başakşehir Çam and Sakura City Hospital Scientific Researches Ethics Committee (Date: 27.11.2024, Decision No: 284).

This retrospective study was conducted on pediatric patients diagnosed with CNLDO who underwent silicone tube intubation between March 2022 and April 2024 at Başakşehir Çam and Sakura City Hospital, a tertiary referral center in İstanbul. Inclusion criteria were; 1: Age between 24 and 72 months; 2: History of unresolved epiphora despite conservative treatment or failed probing; 3: Clinical diagnosis of CNLDO based on symptoms and diagnostic tests.

Patients were divided into two groups according to the type of intubation performed: MCI or BCI. A total of 41 eyes from

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41 patients were included, with 16 undergoing MCI and 25 undergoing BCI.

Diagnosis and Scoring System

Diagnosis of CNLDO was based on a history of persistent tearing, a positive fluorescein dye disappearance test, and evaluation using the Munk score. The Munk score is a standardized 6-point scale to assess epiphora severity:

- **0:** No epiphora
- **1:** Occasional epiphora requiring dabbing less than twice daily
- **2:** Epiphora requiring dabbing 2-4 times daily
- **3:** Epiphora requiring dabbing 5-10 times daily
- **4:** Epiphora requiring dabbing more than 10 times daily or constant tearing
- **5:** Constant tearing with continuous dabbing

Treatment success was defined as a fluorescein disappearance grade of 0 and a Munk score of 0-1 at the 3rd month after tube removal.

Tube Intubation Procedure

All nasolacrimal intubations were performed by two oculoplastic surgeons under general anaesthesia. BCI was performed with a Crawford intubation tube (FCI, Paris, France). Before intubation, a cotton pad containing 2% lidocaine and 0.0125 mg/ml adrenaline was placed in the nasal cavity for 10 minutes. After dilating the upper and lower punctum and probing with Bowman probe, the metal probes in the silicone tube were passed through the upper and lower canaliculi into the nasolacrimal duct and nasal cavity. The distal ends of the probes were grasped with a small paediatric nasal forceps and the metal ends were removed and connected to each other. MCI was performed with a Monoka tube (FCI, Paris, France). After the metal tip was inserted into the nasolacrimal duct through the upper punctum and canaliculus, the tube was pulled out of the nose in a similar manner. The proximal head of the tube was fixed to the ampulla with a slight pull of the metal probe on the nasal tip. The tube was then cut at the entrance of the nasal cavity.

Patients received antibiotics with topical corticosteroids for 7 days and nasal spray for 3 days postoperatively. Patients were examined at 1 week after intubation to look for early complications such as corneal abrasion or tube dislodgement.

All tubes were removed under local anaesthesia. Intraoperative and postoperative complications were recorded.

Statistical Analysis

Mean, standard deviation, median lowest, highest, frequency and ratio values were used in descriptive statistics of the data. Distribution of variables was measured by Kolmogorov Simrnov, Shapiro-Wilk test. Independent sample T test was used in the analysis of quantitative independent data. Chi-square test was used in the analysis of qualitative independent data, and Fischer test was used when chi-square test conditions were not met. Statistical analysis was performed using SPSS software (version 28.0, IBM, Chicago, US).

RESULTS

A total of 41 patients who underwent MCI surgery in 16 eyes and BCI surgery in 25 eyes were evaluated. The mean age of the patients was 43.3±17.6 months and ranged from 24 months to 72 months. Twenty-five (61%) patients were females and 16 (39%) were males. Twenty-one (51.2%) of the patients were right eyes and 20 (47.8%) were left eyes (Table 1).

The mean age was 41.6±18.6 months for the MCI group and 44.6±16.8 months for the BCI group (p=0.319). There were 10 females (62.5%) and 6 males (37.5%) in the MCI group and 15 females (60%) and 10 males (40%) in the BCI group (p=0.872). In terms of laterality, 10 cases (62.5%) in the MCI group were right eyes and 6 cases (37.5%) were left eyes, while 11 cases (44%) in the BCI group were right eyes and 14 cases (56%) were left eyes (p=0.247) (Table 2).

In the MCI group, the intubation tube was absent in one patient (6.3%) at the first-month follow-up. In contrast, five cases of early tube dislodgement occurred in the BCI group-four (16%) within the first month and one (4%) in the second month-while tube removal was completed by the third month in twenty patients (80%) (p=0.628). There was a history of probing in 11 patients (68.8%) in the MCI group and 11

Table 1. Demographic characteristics of patients, probing history, laterality and success rate

		Min-max	Median	Mean±SD/n-%
Age (month)		24.0-72.0	40.0	43.3±17.65
Sex	Female			25, 61.0%
	Male			16, 39.0%
Probing history	(-)			19, 46.3%
	(+)			22, 53.7%
Laterality	Right eye			21, 51.2%
	Left eye			20, 47.8%
Tube	Bicanalicular			25, 61.0%
	Monocanalicular			16, 39.0%
Time to remove the tube (month)	1st			5, 12.2%
	2nd			1, 2.4%
	3rh			35, 85.4%
Presence of complaints in the 3rd month after surgery	(-)			37, 90.2%
	(+)			4, 9.8%

Min: Minimum, Max: Maximum, SD: Standard deviation

Table 2. Comparison of statistical results of MCI and BCI patients

		Bicanalicular tube		Monocanalicular tube		
		Mean±SD/n-%	Median	Mean±SD/n-%	Median	P
Age (month)		44.6±16.8	44.0	41.6±18.6	33.5	0.643[t]
Sex	Female	15, 60.0%		10, 62.5%		0.872[X²]
	Male	10, 40.0%		6, 37.5%		
Probing history	(-)	14, 56.0%		5, 31.2%		0.121[X²]
	(+)	11, 44.0%		11, 68.8%		
Laterality	Right eye	11, 44.0%		10, 62.5%		0.247[X²]
	Left eye	14, 56.0%		6, 37.5%		
Time to remove the tube (month)	1st	4, 16.0%		1, 6.3%		0.628[X²]
	2nd	1, 4.0%		0, 0.0%		
	3rd	20, 80.0%		15, 93.7%		
Presence of complaints in the 3rd month after surgery	(-)	22, 88.0%		15, 93.7%		0.544[X²]
	(+)	3, 12.0%		1, 6.3%		

[t]Independent sample test / [X²]Chi square test (Fischer test), MCI: Monocanalicular intubation, BCI: Bicanalicular intubation, SD: Standard deviation

patients (44%) in the BCI group. No canalicular complications were seen in both groups. Results regarding age, gender distribution and laterality were similar between BCI and MCI groups. Treatment success defined as a fluorescein disappearance grade of 0 and a Munk score of 0-1 was achieved in 15 of 16 eyes (93.7%) in the MCI group and in 22 of 25 eyes (88%) in the BCI group. There was no statistically significant difference in treatment success between the two groups (p = 0.544) (Table 2).

DISCUSSION

CNLDO is a common lacrimal system disorder in children. While most cases improve in the first 12 months with conservative treatment, probing has been recommended as the most effective method in cases between 12-18 months.[7,13] Although silicone intubation is generally used in case of failure of conservative treatment and probing, it is also recommended as the primary procedure in children over 1.5-2 years of age because probing success decreases with age.[14] The silicone tube acts as a temporary stent and prevents obstruction and fibrosis in the nasolacrimal duct during wound healing.[15] For this purpose, MCI and BCI methods have been evaluated in various studies for silicone intubation.[16-19] In BCI, the silicone tube is passed through both canalicular systems into the nasal cavity, while in MCI, the tube is passed through a single canaliculus into the nasal cavity. This exposes a single canaliculus to trauma in MCI. Studies have shown that monocanalicular or bicanalicular tube use has similar success rates on treatment success and there is no statistically significant difference.[16,20] However, although some authors have shown that BCI and MCI have similar success rates, they prefer monocanalicular tube intubation in terms of ease of placement and removal of the tube, as well as lower incidence of canalicular trauma.[10,19] Our findings support previous literature showing no significant difference in success rates between monocanalicular and bicanalicular intubation techniques.

In previous studies, a low success rate was observed in the BCI and MCI groups with age.[19,21] Rajabi et al.[22] reported that the success rate decreased with advancing age in the BCI group, but age had no effect on success in the MCI group. In this study, we did not observe a meaningful difference in the success rates in children aged 2-6 years who underwent BCI and MCI.

The timing of removal of silicone intubation tubes has been reported as the 3rd month in most studies.[10,16,19] Katowitz et al.[12] suggested that, beyond preventing re-epithelialisation and adhesions, silicone tubes may enhance surgical success by applying physical pressure that stimulates bone growth during early childhood. This is supported by higher failure rates in patients who lost the stent before 3 months or were older than 4 years. El- Essawy et al.[23] evaluated the relationship between the results of silicone intubation and the time of tube removal and reported that early tube removal (approximately two months) did not affect the success rate in children younger than 2 years of age, but in older children, the tube should be removed after at least 3 months. Peterson et al.[24] also reported that removal of the tube before 4-6 weeks significantly increased the necessity for reoperation in children older than 2 years. İn a study by Lim et al.[25] regarding the longer retention of the tubes, they concluded that retention for longer than 12 months showed a significantly lower success rate. In line with most previous studies, silicone tubes in our study were also removed at the third postoperative month.

In studies on the placement of MCI tubes in the upper or lower canaliculus, there are studies indicating that in patients in whom monocanalicular tubes are placed in the upper canaliculus, especially depending on the length and size of the head of the tube, corneal abrasions or ulcers may occur.[21,26] However, Katowitz et al.[12] reported that the complication rate of MCI tubes placed in the upper canaliculus is lower than those placed in the lower canaliculus because the upper punctum is usually more medial and further away from the corneal limbus compared to the lower punctum. In our cases, MCI tubes were placed in the upper canaliculus due to its favorable anatomical accessibility and because, in the event of eye rubbing, the lower canaliculus is more likely to come into contact with the ocular surface. This approach aimed to reduce the risk of corneal irritation and we did not observe any complications in the cornea and conjunctiva in the patients we evaluated postoperatively.

Possible complications of BCI include punctal cleft, displacement of the tube, infection, corneal abrasion, and the tube remaining in place after cutting the cantalum part of the tube.[19,23,25,27] In 1 of the patients who underwent MCI, we could not observe the tube in place in the 1st month. Epiphora symptoms of this patient continued. In 5 patients in whom BCI was removed earlier due to displacement of the tubes, we observed that postoperative epiphora complaints persisted.

During BCI application, tubes removed from the inferior meatus are connected for tube stabilisation. There are different recommendations and studies in the literature. Andalib et al.[16] tied the BCI tube ends with 8 or 10 knots and removed the tube under general anaesthesia, Lee et al.[19] fixed the distal ends to the lateral nostril with 7-0 nylon without tying them together for easy removal of the tubes during BCI, so that the proximal ring of the tube close to the punctum was held with forceps and the tube was removed under topical anaesthesia. In this study, BCI tubes were secured with two square knots. For removal, the tube was grasped from the lower punctum with forceps, gently rotated to expose the knot, and cut just below it with scissors. This method allowed safe removal in the outpatient clinic under local anesthesia, without the need for a second general anesthesia.

Unlike many previous studies that include a broader age range or combine outcomes from various surgical techniques, our study specifically focuses on children aged 2 to 6 years-a group in which probing success typically declines and intubation becomes more relevant. Moreover, the study highlights the practical advantage of MCI, including its stability and simplified outpatient removal, supporting its use in routine pediatric practice without compromising success rates.

Limitations

This study has several limitations. First, its retrospective design may be prone to inherent biases related to data collection and patient selection. Second, the sample size was relatively small, and all procedures were performed at a single tertiary referral center by only two surgeons, which may limit the generalizability of the findings. Third, the follow-up period was limited to three months after tube removal, and long-term outcomes could not be assessed. Lastly, treatment success was defined using clinical grading scales, which, although standardized, may still include subjective components.

CONCLUSION

This study confirms that both MCI and BCI silicone intubation are effective for the surgical treatment of CNLDO in children aged 2 to 6 years. While overall success rates were similar, MCI was associated with fewer early tube dislodgements and offered greater procedural simplicity. These findings, in alignment with prior literature, support the consideration of MCI as a practical and efficient alternative, particularly in clinical scenarios where technical ease and reduced intervention time are prioritized.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Başakşehir Çam and Sakura City Hospital Scientific Researches Ethics Committee (Date: 27.11.2024, Decision No: 284).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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