# Monocanalicular silastic intubation for the initial correction of congenital nasolacrimal duct obstruction

J. Mark Engel, MD,[a] Claire Hichie-Schmidt, DO,[b] Alexander Khammar, MD,[c] Barbara M. Ostfeld, PhD,[d] Amy Vyas, MD,[a] Benjamin H. Ticho, MD[c]

**BACKGROUND** Treatment of persistent nasolacrimal duct (nasolacrimal duct obstruction) obstruction traditionally has consisted of simple probing. The most common complication with this approach has been recurrent obstruction, requiring another probing, often with the use of bicanalicular silastic intubation. Monocanalicular silastic tubing offers the possibility of increased success rates over simple probing while theoretically minimizing the insertion and removal difficulaties posed by bicanalicular techniques. We report, to our knowledge, the largest series to date of patients undergoing monocanalicular silastic intubation, as well as the first report evaluating this technique as the primary treatment for congenital nasolacrimal duct obstruction obstruction.

**METHODS** This was a retrospective chart review of 635 children treated by 3 pediatric ophthalmologists via probing with monocanalicular silastic intubation as the initial procedure for congenital nasolacrimal duct obstruction obstruction. Success was defined as good clearance of fluorescein dye and/or the absence of symptomatic tearing. Failure was defined as recurrent symptomatic tearing or inadequate clearance of fluorescein dye, leading to the performance of a second tear duct operation.

**RESULTS** We identified 635 children who underwent probing with monocanalicular intubation as the primary treatment for congenital nasolacrimal duct obstruction obstruction (mean age at time of probing 18 months). The overall success rate for the 803 eyes undergoing surgery was 96%. The success rate for treatment performed in infants younger than 24 months of age (684 eyes) was 97%, declining to 90% when surgery was performed in infants older than 24 months of age (119 eyes; $p < 0.001$). These success rates compare favorably to previous reports of primary probing without silastic intubation, especially in children older than 12 months at the time of the probing. The only complication in the current study was conjunctival–corneal abrasion, occurring in 2% of cases.

**CONCLUSIONS** Probing with monocanalicular silastic intubation as the initial surgical procedure for patients with congenital nasolacrimal duct obstruction obstruction is associated with a very high success rate and low complication rate, especially when performed by the age of 24 months. (J AAPOS 2007;11:183-186)

Congenital nasolacrimal duct obstruction occurs in as many of 20% of infants.[1] Resolution, either spontaneously or with digital massage of the nasolacrimal sac, occurs in the vast majority of patients by the age of 12 months.[1,2]

*Author affiliations:* [a]*UMDNJ-Robert Wood Johnson Medical School, New Brunswick, New Jersey;* [b]*UIC Eye & Ear Infirmary, Chicago, Illinois;* [c]*University of Illinois, Chicago, Illinois,* [d]*Department of Pediatrics, UMDNJ-Robert Wood Johnson Medical School, New Brunswick, New Jersey*

*Presented in part at the American Association for Pediatric Ophthalmology and Strabismus annual meeting, April 2000, American Academy of Ophthalmology annual meeting, New Orleans, LA, November 2001, the Pediatric Ophthalmology Subspecialty Meeting of the American Academy of Ophthalmology, Chicago, IL, October 2005.*

*None of the authors have any financial interest regarding the subject matter of this manuscript.*

*Submitted April 9, 2006.*

*Revision accepted September 12, 2006.*

*Reprint requests: J. Mark Engel, MD, Department of Ophthalmology, Robert Wood Johnson Medical School, 4 Cornwall Court, East Brunswick, NJ 08816 (email: engel@uceyecenter.com).*



*1091-8531/2007/$35.00 + 0*

*doi:10.1016/j.jaapos.2006.09.009*

Treatment of persistent nasolacrimal duct obstruction traditionally has consisted of simple probing. The most common complication with this approach has been persistent obstruction, requiring reprobing, often with supplementary silastic intubation or balloon catheter dilation.[3-5]

Bicanalicular silastic intubation traditionally has not been recommended for the initial probing, in part because of the difficulty in placing and maintaining the tube in the desired position[6] and the frequent need for general anesthesia for tube removal. In contrast, a technique using monocanicular silastic tubing recently has been described, being generally less traumatic than bicanalicular intubation and relatively simple to perform, with the silastic tubing easily removed in the office setting.[7] We postulated that probing with monocanalicular intubation would increase the overall success rate compared with simple probing. We report the largest series to date of patients undergoing monocanalicular silastic intubation, as well as the first report evaluating

this technique as the primary treatment for congenital nasolacrimal duct obstruction obstruction.

## Subjects and Methods

The case files of all patients who underwent probing with monocanalicular silastic intubation as the primary treatment for congenital nasolacrimal duct obstruction obstruction by 3 surgeons (JME, AK, BHT) were reviewed. The time span of the analysis differed for the 3 surgeons, depending on when the surgeon started to use this method exclusively for primary nasolacrimal duct obstruction obstruction treatment. For BHT, all case files of patients who underwent nasolacrimal duct probings from January 1998 to May of 2005 were examined (n = 389). For AK (n = 62) and JME (n = 184), all patients who underwent probings from January of 2002 to May of 2005 were examined.

Patients were excluded from the study if they had a history of Down syndrome, mucocele, previous nasolacrimal duct obstruction procedure, follow-up less than 6 weeks after the surgery (1 patient), or were younger than 6 months of age at the time of the probing. Institutional review board approval was obtained through Robert Wood Johnson University Medical School and through Midwestern University. All patients included in the study met the authors' criteria for the presence of a nasolacrimal duct obstruction obstruction: the child had both a history of recurrent tearing in one or both eyes for greater than 6 months and had an abnormal fluorescein dye disappearance test. We identified 635 patients who met the above inclusion criteria.

We considered the nasolacrimal duct probing successful if, at the last date of examination (after tube removal), there was an absence of symptomatic tearing, and examination revealed either no enlargement of the tear lake or results from a fluorescein dye disappearance test were normal. Recurrence of the nasolacrimal duct obstruction obstruction was specified if any of the following were present: (1) recurrent symptomatic tearing after removal of the silastic tube, (2) inadequate clearance of fluorescein on the dye disappearance test, or (3) a second nasolacrimal duct surgery was performed. Tearing noted only during upper respiratory infection or exposure to wind was not judged as evidence of persistent obstruction if no other signs or symptoms were present.

Two authors (BHT and AK) notated the type of obstruction found in 580 eyes as either simple or complex.[8] The obstruction was considered simple if a single blockage was found toward the distal end of the nasolacrimal duct and opened without much resistance. Obstruction(s) were considered complex if found at or above the nasolacrimal duct-sac juncture or if there was significant narrowing throughout the system.

We reviewed the charts for any potential complications that have been reported using both monocanalicular and bicanalicular tubing. We also recorded the time of removal of the tube (by surgeon or patient) and any spontaneous loss of the tube.

### Statistical Analysis

Descriptive data were presented as frequencies and percentages. For comparisons of categorical variables we used $\chi^2$ analyses. Medians and first and third quartiles were calculated for continuous measurements, and comparisons were made with the Mann-Whitney $U$ test. Odds ratios were calculated by logistic regression analysis. A $p$ value <0 0.05 denoted a statistically significant difference. All of the $p$-values were $t$-sided.

### Surgical Technique

All children underwent general anesthesia, using mask inhalation, laryngeal mask, or endotracheal intubation. Standard probing was performed immediately before insertion of the silastic tube. The technique used for Ritleng Monoka monocanalicular intubation was similar to that previously described,[7] with minor variations. We universally placed the tube through the upper punctum, advancing the monocanalicular polypropylene mesh "leader" through the stylet either manually or with a needle holder or hemostat. The tubing was retrieved in the nasal cavity with a Ritleng or Crawford hook, typically engaging the polypropylene mesh leader by twisting or rotating the hook just under the terminal end of the stylet. We inserted the 3-mm collarette into the upper punctum either by placing digital tension on the silastic tubing through the nasal cavity, or by the aid of the Ritleng punctal inserter. Antibiotic or antibiotic-steroid ointment was applied at the conclusion of the procedure.

Postoperative care included the use of antibiotic or antibiotic-steroid ointment for 3-10 days after the procedure, depending on surgeon preference. The tube was removed in the office by grasping the collarette with a smooth conjunctival forceps. This was easily accomplished without a topical anesthetic.

## Results

A total of 635 patients (803 eyes) met the study's inclusion criteria, with slightly more women (55%) than men (45%). Of the 467 (58.2%) unilateral cases, 254 (54.3%) had involvement of the right eye, and 213 (45.6%) the left eye. The ages ranged from 6.5 months to 103.8 months (8.7 years). The median patient age at time of probing was 15.2 months (first and third quartile: 13.0, 20.4). The median follow-up (calculated from date of surgery) was 12 weeks (first and third quartile: 8, 28).

In total, there were 31 recurrences (3.8%). Patients with a recurrence were older, with the median age at time of probing of 21.2 months (first and third quartile: 14.0, 30.0) for eyes with recurrence and 15.4 (first and third quartile: 13.0, 20.4) for eyes with no recurrence ($p < 0.05$). Compared with patients probed between 6 and 12 months, those probed between ages 12.1 and 18 months or between 18.1 and 24 months were at no greater risk for recurrence. In these groups, 2.5–2.7% of probes had recurrences. However, for those probed after 24 months, 10% had recurrences (odds ratio = 4.72, 95% confidence interval = 1.5, 14.9; Table 1). There was no significant difference between surgeons on the rate of recurrence ($p = 0.6253$). The failure rate was similar for complex obstructions (4 of 85 eyes = 4.7%) versus simple obstructions (17 of 494 eyes = 3.4%). There was no difference in recurrence rates between right and left eyes ($p = 0.52$) or between unilateral versus bilateral obstructions ($p = 0.39$).

Table 1. Recurrence of NLD obstruction related to age at time of monocanalicular silastic tube intubation

| Age at probing (mo) | n | Recurrence number (%) | OR (95% CI) |
|---|---|---|---|
| 6-12 | 157 | 4 (2.5%) | 1.00 |
| 12.1-18 | 368 | 10 (2.7%) | 1.07 (0.33, 3.48) |
| 18.1-24 | 159 | 4 (2.5%) | 1.01 (0.24, 4.10) |
| Greater than 24 | 119 | 13 (10.9%) | 4.72 (1.50, 14.89)* |

*CI:* confidence interval; *NLDO:* nasolacrimal duct obstruction; *OR:* odds ratio
*$p < 0.01$.

In 685 cases (85.1%), the tube was removed in the office. The median number of weeks the probe was in place was 8.0 (first and third quartile: 8, 12). In the remaining 116 cases, the tube was either found to be absent on follow-up examination, or, rarely, found dislodged by the parents and removed in the office before the date that the removal was planned. There was no difference in age between those patients in whom the tube was lost spontaneously and those who had the tube removed in the office ($p = 0.13$). The recurrence rate was not increased after premature tube loss compared with patients who had the tube removed in the office ($p = 0.41$).

Complications in our series were limited to conjunctival or corneal abrasions occurring in 16 eyes (2%) of 16 patients, necessitating tube removal to prevent further trauma. The abrasions were transient, resolving without sequelae within 1-3 days of tube removal in all cases. The amount of time that the tube was kept in was therefore shorter for those eyes with abrasions (median = 3.0 weeks, first and third quartile: 1.3, 6 weeks) than for those without abrasions (median = 8.0 weeks, first and third quartile: 8, 12 weeks; $p < 0.001$). The rate of conjunctival–corneal abrasions did not differ among the 3 surgeons ($p = 0.83$) and was not statistically related to the age at time of probing ($p = 0.16$). The rate of recurrent tearing (one patient, 6.25%) was not increased for the 16 patients who had the tube removed early because of irritation or corneal abrasion.

## Discussion

In the past, silastic tube intubation has been reserved for patients who failed previous simple probings or who presented at advanced ages during which the risk of simple probing failure was judged to be increased. The results of the current study suggest that, for patients requiring general anesthesia for treatment of nasolacrimal duct obstruction, monocanalicular silastic tube intubation may reduce the recurrence and reoperation rate over simple probings while still being associated with a very low complication rate.

Although the current study has no simple probing control group to directly compare the impact of intubation on recurrent nasolacrimal duct obstruction, our overall success rate of 96.2% compares favorably with historical reports (Table 2).[9-15] The current study's success rate also compares favorably with balloon dacryocystoplasty which although it has found a high success rate for recurrent nasolacrimal duct obstruction,[5,16,17] appears to offer no significant advantage over simple probing as a primary treatment.[18,19]

The timing of surgical intervention for nasolacrimal duct obstruction is controversial. Several studies have found a significant increase in the recurrence rate in those patients undergoing probing after the age of 12 months,[9,10,14] which has led to the recommendation of probing children before the age of 13 months. Other authors, however, have found no correlation of recurrence rate with age at probing.[11]

Our series revealed a significant association between the recurrence rate and the age of the patient when the probing was performed. However, our recurrence rate was virtually the same up to 24 months of age, with a recurrence rate of 2.5% at 6-12 months of age, 2.7% at 12-18 months of age, and 2.5% at 18-24 months of age. After the age of 24 months, the overall recurrence rate increased significantly, although still at a relatively low rate of 10.9% ($p < 0.01$). Thus, for parents or practitioners who prefer to delay primary treatment beyond 12 months, the current study suggests that such a delay may not result in a reduced success rate when primary intubation is employed.

One advantage of using monocular rather than bicanalicular tubing is that no further manipulation after insertion is necessary except for the (usually straightforward) removal of the tube in the office. Bicanalicular tubes occasionally require sedation for surgical repositioning of a displaced tube and for removal. Conversely, although the monocanalicular tube was lost before scheduled office removal in 116 eyes (14.5%) in the current series, no repeat surgical or anesthetic interventions were required in these patients. Recurrences were not more frequent after premature tube loss compared with patients who had the tube removed in the office. Although this may suggest that silastic tubing is effective even if left in place less than 2 to 3 months, there were insufficient number of early removals to evaluate this adequately in our study.

Some studies have shown that the success rate correlates significantly with the type of obstruction. Kushner,[8] in a study of 22 children between the ages of 18 months and 48 months, found a 100% success rate in children with simple obstructions versus a 36% success rate with complex obstructions. In a study of 138 eyes of patients ages 13-60 months, Kashkouli et al[20] also reported a high success rate in eyes with simple obstructions (90.2%) versus complicated obstructions (33.3%). Conversely, the current study had similar success rates among simple and complex obstructions, suggesting the primary use of monocanalicular tubing may be particularly indicated in children with complex obstructions.

The only complication found in this series was a 2% risk of conjunctival or corneal abrasion. This incidence may be minimized by using postoperative ointment and instructing the parents to avoid eye rubbing, particularly immediately after the procedure and continue for up to the first 2 weeks after the procedure. All of the ocular surface abrasions resolved

Table 2. Comparison of success rates of simple probings

| Study | No. of eyes probed | Success rate of simple probing by age of patients | | |
|---|---|---|---|---|
| | | 0–12 mo | 12.1– 24 mo | 24 mo and greater |
| Katowitz and Welsh (1997)[9] | 572 | 97% | 69% | 33.3% |
| Zwaan (1997)[10] | 110 | 97% | 88% | 92% |
| Robb (1998)[11] | 280 | 98% from 0 to 24 mo | | 100% |
| Mannor (1999)[12] | 142 | 92% | 89% | 69% |
| Honavar (2000)[13] | 60 | All patients ≥ 24 mo of age | | 73% (median age 33 mo) |
| Kashkowli and Kassaee (2002)[14] | 207 | 92% | 85% | 65% |
| Lee and Fudenberg (2005)[15] | 138 | Age range 4.5 to 36 mo (average, 12.4) Success rate 86% | | |

within 24 hours of removal of the tube. Kaufman and Guay-Bhatia[7] reported a much higher complication rate, possibly in part because they typically intubated the lower punctum, which is more likely to incur patient manipulation than intubation of the upper punctum, as in the current study.

Although our median follow-up was only 12 weeks after surgery (minimum 6 weeks), both we and others[21] have found that recurrences usually occur within the 3-month postoperative period. In our study, the duration of follow up did not correspond with an increase risk for re-occurrence ($p = 0.74$).

We found that monocanalicular silastic intubation did not increase the duration of surgery compared with simple probing, in part because fluorescein irrigation was not performed in patients undergoing tube placement. Because of the relative speed of this procedure, endotracheal intubation and even intravenous access is often deferred by our anesthesiologists. The cost of the monocanalicular tube in primary nasolacrimal duct obstruction obstruction treatment may be offset by the reduced frequency of re-operation. Parental acceptance of primary intubation has also been very high, particularly when the reduced reoperation rate is discussed.

Egbert stated that "the effectiveness of probing, intubation of the nasolacrimal system, and external dacryocystorhinostomy is so high that, in order for alternative treatments to show increased effectiveness, hundreds of patients would need to be recruited for studies."[22] The current study, with 803 cases performed by 3 surgeons, does raise the success standard, albeit retrospectively, and against historical, rather than randomized, controls. A large, prospective randomized, study would be necessary to more directly evaluate the advantages and disadvantages of silastic intubation versus simple probing in the initial treatment of congenital nasolacrimal duct obstruction obstruction.

## References


1. MacEwen CJ, Young JDH. Epiphora during the first year of life. Eye 1991;5:596-600.
2. Peterson RA, Robb, RM The natural course of congenital obstruction of the nasolacrimal duct. J Pediatr Ophthalmol Strabismus 1978;15:246-50.
3. Leone CR, Van Gemert JV. The success rate of the silicone intubation in congenital nasolacrimal duct obstruction. Ophthalmic Surg 1989;5:43-8.
4. Migliori ME, Putterman AM. Silicone intubation for the treatment of congenital lacrimal duct obstruction; successful results removing the tubes after six weeks. Ophthalmology 1988;95:792-5.
5. Hutcheson KA, Drack AV, Lambert SR. Balloon dilatation for treatment of resistant nasolacrimal duct obstruction. J AAPOS 1997;1:241-4.
6. Merbs SL, Harris LL, Iwamoto MA, Iliff NT. Prevention of prolapsed silicone stents in lacrimal intubation using an intrasac fixation suture. Arch Ophthalmol 1999;117:1092-5.
7. Kaufman LM, Guay-Bhatia LA. Monocanalicular intubation with Monoka tubes for the treatment of congenital nasolacrimal duct obstruction. Ophthalmology 1998;105:336-41.
8. Kushner BJ. The management of nasolacrimal duct obstruction in children between 18 months and 4 years old. J AAPOS 1998;2:57-60.
9. Katowitz JA, Welsh MG. Timing of initial probing and irrigation in congenital nasolacrimal duct obstruction. Ophthalmology 1997;94: 698-705.
10. Zwaan J. Treatment of congenital nasolacrimal duct obstruction before and after the age of 1 year. Ophthalmic Surg Lasers 1997;28:932-6.
11. Robb RM. Success rates of nasolacrimal duct probing at time intervals after 1 year of age. Ophthalmology 1998;105:1307-10.
12. Mannor GE, Rose GE, Frimpong-Ansah K, Ezra E. Factors affecting the success of nasolacrimal duct probing for congenital nasolacrimal duct obstruction. Am J Ophthalmol 1999;127:616-7.
13. Honavar SG, Prakash VE, Rao GN. Outcome of probing for congenital nasolacrimal duct obstruction in older children. Am J Ophthalmol 2000;130:42-8.
14. Kashkouli MB, Kassaee A, Tabatabaee Z. Initial nasolacrimal duct probing in children under age 5: cure rate and factors affecting success. J AAPOS 2002;6:360-3.
15. Lee DH, Fudemberg SJ, Davitt BV, Cruz OA. Success of simple probing and irrigation in patients with nasolacrimal duct obstruction and otitis media. J AAPOS 2005;9:192-4.
16. Goldstein SM, Goldstein JB, Katowitz JA. Comparison of monocanalicular stenting and balloon dacryoplasty in secondary treatment of congenital nasolacrimal duct obstruction after failed primary probing. Ophthal Plast Reconstr Surg 2004;20:352-7.
17. Tao S, Meyer DR, Simon JW, Zobal-Ratner J. Success of balloon catheter dilatation as a primary or secondary procedure for congenital nasolacrimal duct obstruction. Ophthalmology 2002;109:2108-11.
18. Lueder GT. Balloon catheter dilation for treatment of older children with nasolacrimal duct obstruction. Arch Ophthalmol 2002;120: 1685-8.
19. Gunton KB, Chung CW, Schnall BM, Prieto D, Wexler A, Koller HP. Comparison of balloon dacryocystoplasty to probing as the primary treatment of congenital nasolacrimal duct obstruction. J AAPOS 2001;5:139-42.
20. Kashkouli MB, Beigi B, Parvaresh MM, Kassaee A, Tabatabaee Z. Late and very late initial probing for congenital nasolacrimal duct obstruction: what is the cause of failure? (extended report). Br J Ophthalmol 2003;3:1151.
21. Burns SJ, Kipioti A. Follow-up after probing for congenital nasolacrimal duct obstruction. J Pediatr Ophthal Strabismus 2001;38:163-5.
22. Egbert JE. Congenital nasolacrimal duct obstruction. J AAPOS 2001;5:133.