Balloon Catheter Dilation for Treatment of Older Children With Nasolacrimal Duct Obstruction

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Objectives: To describe the outcomes of balloon catheter dilation of the lacrimal duct as the first surgical treatment for older children (≥18 months) with nasolacrimal duct (NLD) obstruction and to examine the effect of the type of obstruction on outcome.

Design: Retrospective noncomparative case series.

Participants: Seventy-six children 18 months or older with NLD obstruction who had not undergone previous surgery.

Intervention: The patients underwent NLD probing, infracturing of the inferior turbinate, and balloon catheter dilation of the distal NLD. The type of obstruction was noted at surgery.

Main Outcome Measures: Outcomes were considered excellent if the patient had complete resolution of epiphora and dacryocystitis and normal tear drainage on examination, good if the patient had only minimal residual symptoms or a minimally delayed dye disappearance test result, fair if the patient had moderate residual symptoms or delayed tear drainage, and poor if there was no improvement.

Results: Seventy-six children were treated. Overall, results were excellent in 28 (37%) patients, good in 30 (39%), fair in 13 (17%), and poor in 5 (7%). Forty-eight (63%) of the patients had simple membranous obstruction at the Hasner valve. Results were good or excellent in 35 (73%) of these patients. Twenty-eight (37%) patients had stenosis that extended along the length of the distal NLD. Results were good or excellent in 23 (82%) of these patients.

Conclusions: Balloon catheter dilation is probably more effective than simple probing for older children with NLD obstruction because of stenosis that extends along the distal NLD. The procedure does not provide a significant advantage over simple NLD probing in patients with typical membranous obstruction at the Hasner valve.

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NASOLACRIMAL DUCT (NLD) obstruction is a common childhood problem that usually resolves spontaneously within the first few months of life. If treatment is required, topical antibiotics and nasolacrimal massage are commonly recommended initially. If the symptoms do not resolve with age and medical management, most ophthalmologists recommend treatment with NLD probing. Some practitioners prefer patients to undergo probing at a young age (4-6 months) in the office, while others prefer to defer surgery until an older age (9-12 months) and to perform the surgery under general anesthesia.1 There is no clear consensus as to which of these methods is preferable.2 The success rate for both strategies is excellent, typically greater than 90%.

The optimal treatment for older children with NLD obstruction has been the subject of debate. Previous reports3,4 have suggested that the success rate of NLD probing decreases with advancing age. Because of this, some ophthalmologists place lacrimal stents, in addition to NLD probing, as a first procedure in older children with NLD obstruction. More recently, Robb5 and Kushner6 have reported better success rates with simple NLD probing in older children, and they have questioned the need for stent placement in these patients. The reason for this difference in reported success rates is unclear, but it may be related to different types of nasolacrimal obstruction that may be present in older children.

Balloon catheter dilation (BCD) of the NLDs was originally described by Munk et al7 for adults with epiphora. The procedure was performed using an angioplasty catheter under fluoroscopic guidance. Becker et al8 have designed a catheter for children that is placed in the NLD in a manner similar to NLD probing. The catheter has a balloon at its tip that is inflated hydrostatically, thus allowing a significantly greater dilation of the distal NLD than is possible with nasolacrimal probes alone. This article describes the outcomes of BCD in 76 patients with NLD obstruction who were 18 months or older at their first surgery. The specific type of obstruction was noted intraoperatively, and the results were ana-
The results were graded as follows, based on the medical history and findings on clinical examination: (1) excellent, complete resolution of symptoms and normal dye disappearance test results; (2) good, marked improvement, but with either a history of occasional mild abnormal tearing and/or periorcular discharge and a normal examination result or no reported symptoms but minimal delay on dye disappearance testing; (3) fair, improvement, but with moderately delayed tear drainage and/or periorcular discharge; and (4) poor, no improvement in abnormal tearing or dacryocystitis.

If the patient had bilateral NLD obstruction, the results were based on the eye with the poorer outcome. If follow-up information was obtained by telephone interview, the outcome was considered good if the parents reported complete resolution of symptoms.

### RESULTS

Seventy-six children were treated with BCD (age range, 18-116 months; mean age, 29 months). The symptoms were bilateral in 48 (63%) patients and unilateral in 28 (37%). Follow-up ranged from 3 weeks to 26 months following surgery. Sixty-nine (91%) patients returned for at least 1 postoperative examination, and outcome information was obtained by telephone interview for the remaining 7 patients. The outcomes were the same in both eyes in all but 4 of 48 patients with bilateral obstruction. In these 4 patients, the outcomes were fair/poor, fair/good, fair/excellent, and good/excellent. Overall results following BCD were excellent in 28 (37%) patients, good in 30 (39%), fair in 13 (17%), and poor in 5 (7%). No surgical or anesthesia-related complications occurred.

Forty-eight patients (63%) had typical findings of NLD obstruction during passage of the probes, with either minimal stenosis or a membranous obstruction at the distal Hasner valve. In this group, results were excellent in 19 (40%) patients, good in 16 (33%), fair in 10 (21%), and poor in 3 (6%).

Twenty-eight patients (37%) had palpable stenosis that extended along the distal NLD. In this group, results were excellent in 9 (32%) patients, good in 14 (50%), fair in 3 (11%), and poor in 2 (7%).

One patient had membranous obstruction of the lacrimal puncta. Results in this patient were good following punctal dilation and BCD. Marked canalicular stenosis was not found in any patient. Five patients were excluded from the study because nasolacrimal stents were placed during the same procedure. The stents were placed because the patients had marked reflux on attempted irrigation of the lacrimal system following BCD. One of the patients had an excellent outcome, 3 had good outcomes, and 1 had a poor outcome.

The results were analyzed by age. The outcomes are summarized in the Table.

Of the 5 patients with poor outcomes following BCD, 4 were subsequently treated with repeat NLD probing and placement of silicone stents. Outcomes were excellent in 2 patients and fair in 2 patients.

### COMMENT

The optimal treatment for older children with NLD obstruction is unclear. Many studies have suggested that...
the success rate of NLD probing decreases with advancing age. Katowitz and Welsh\textsuperscript{4} described 427 patients in whom the success rate of initial probing was 97% for those younger than 13 months, 76% for those between 13 and 18 months, and 33% for those older than 24 months. Paul and Shepherd\textsuperscript{3} reviewed the literature on NLD obstruction and found that the risk of probe failure doubled every 6 months. Mannor et al\textsuperscript{9} also reported a stepwise decrease in the success of NLD probing, decreasing from 92% at the age of 12 months to 42% at the age of 60 months. Because of these studies, some ophthalmologists routinely place silicone stents during NLD probing in older children in an attempt to increase the success rate of the procedure. In contrast to the studies previously cited, Robb\textsuperscript{5} and Kushner\textsuperscript{6} reported improved success rates in older children with NLD obstruction treated with simple NLD probing. In Robb’s series of patients, most of whom had not undergone previous surgery, greater than 90% of children 18 months or older were cured with simple NLD probing. The present study was designed to assess the effectiveness of BCD in older children with NLD obstruction and to investigate the effect of the type of obstruction on outcome.

The reason for the difference in previously reported outcomes of NLD probing in older children is unclear, but there are at least 2 factors that contribute to the discrepancy. The first is that the patient populations and treatment methods in most published reports are not uniform. Many studies\textsuperscript{5,10,11} did not separate patients into those who had and had not undergone previous NLD surgery. In another report,\textsuperscript{16} some patients were treated with simple NLD probing, while others were treated with simultaneous silicone stent placement. This variability makes it difficult to draw conclusions regarding the reasons for differences in reported outcomes.

The second reason for this discrepancy is that there is more than one type of NLD obstruction in older children. Few previous reports have attempted to identify such differences. In a study by Kushner,\textsuperscript{6} 23 patients with NLD obstruction who were 18 months or older at surgery were separated into those with simple membranes at the Hasner valve and those with complicated obstructions (defined as unusual resistance in either the canaliculus or the distal NLD). In the former group (52% of the patients), the success rate was 100% with simple NLD probing. The success rate for children with complicated obstructions (48% of the patients) was only 36%. Honavar et al\textsuperscript{13} also noted different types of obstruction in a report of 60 patients 24 months or older. In this study, patients were divided into those with membranous and those with firm obstructions. A membranous obstruction was found in 77% of the patients, and 89% of these patients had successful outcomes with a single probing. Firm obstruction was found in 23% of the patients, with a success rate of only 21% with a single probing.

There are at least 2 types of NLD obstruction in older children. Most patients have typical membranous obstruction at the distal Hasner valve (Figure 1). This was present in 48 (63%) of the patients in the present series, 52% of the patients described by Kushner,\textsuperscript{6} and 77% of the patients described by Honavar et al.\textsuperscript{13} Direct comparison of the outcomes in this study with those of earlier reports is difficult, for the reasons previously noted. However, BCD does not seem to offer a significant advantage in the treatment of these patients (35 [73%] with a good or an excellent result in the present study) when compared with the findings of previously published reports.\textsuperscript{5,6,12,13}

The second mechanism for NLD obstruction in older children is stenosis that extends along the length of the distal NLD (Figure 2). Balloon catheter dilation seems to offer a significant benefit in treating patients with this type...
of obstruction. Stenosis along the distal duct was found in 28 (37%) of the patients in the present study, and 23 (82%) had good or excellent outcomes following BCD. These results are much better than the 21% success rate Honavar et al reported using simple NLD probing in patients with firm obstruction and the 36% success rate reported by Kushner in patients with complicated obstruction. The latter study cannot be compared directly with the present study, however, because canalicular stenosis was also included in the complicated group, and the number of such patients is not reported. The design of BCD is well suited for the treatment of patients with obstruction along the distal duct, because the balloon provides for expansion along the entire length of the stenotic duct, thus decreasing resistance and improving tear drainage.

The primary advantage of BCD over placement of lacrimal stents is the avoidance of potential complications associated with the latter. These include premature dislodging of the stents, punctal elongation, corneal abrasions, and the possible need for general anesthesia to remove the stents. The primary disadvantage of the procedure is the cost associated with the instrumentation. The hospital cost for the equipment is approximately $268. In this study, the same catheter was used in both eyes in patients with bilateral NLD obstruction.

The findings of the present study provide contradictory results for the effect of age on outcomes of NLD probing. Supporting the assertion that the success rate of NLD probing decreases with advancing age was the overall 76% good or excellent outcomes in this study (58 of 76 patients), which is less than the greater than 90% success that is usually associated with probing at 12 months or younger. However, when analyzed by age, the children who were 37 months or older in this study had better outcomes (100% had good or excellent outcomes) than younger children. The reasons for this are not clear, but there are 3 possible explanations. The first possible reason is that children in different age groups could have different types of stenosis. In this study, however, this factor cannot explain the increased success rate in older children, because the percentage of patients in the older group with typical membranous stenosis (75% of 12 patients) was similar to that of the overall group (48% of 76 patients). The second possibility is that the difference is not real, but the ability to detect true differences in outcome is limited by the small sample size, particularly in the older group. The third possible explanation is a selection bias, as parents of patients with less severe obstruction may wait until an older age to seek medical attention and, therefore, such obstructions could be more amenable to treatment.

In addition to BCD, all patients in this study also underwent simultaneous intubation of the inferior turbinate. This was performed to decrease the resistance to outflow of the tear drainage and to allow endoscopic visualization of the distal duct. This has been reported to increase the success rate of NLD probing, and has been advocated as an alternative to stent placement by some. Because both procedures were performed, it is not possible to quantify the relative contribution of inferior turbinate intubation and BCD to the outcomes. Similarly, 5 patients were excluded because of the placement of nasoalacral stents during BCD.

Four of these patients had good or excellent results, but it is not possible to independently assess the effect of BCD vs stent placement in these patients.

Based on the findings of this study, my approach in older children with NLD obstruction who require surgery is as follows: NLD probing with intubating the inferior turbinates is performed. If a typical membranous obstruction at the Hasner valve is present and is relieved with passage of the probes, and fluid irrigates easily following the probing, no further procedures are performed. If the patient has gummy or bony palpable stenosis that extends along the distal NLD, BCD is performed. Based on the available data, BCD in patients with the latter type of obstruction seems to be a safe and more effective treatment for improving lacrimal outflow than simple NLD probing.

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