16

Pediatric Balloon Catheter Dacryocystoplasty

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Balloon catheter dacryocystoplasty (DCP) is a very effective treatment for congenital nasolacrimal duct obstruction in children who have failed probing or silicone intubation, or as a primary procedure in children older than 12 months of age.

Resolution of congenital nasolacrimal duct obstruction occurs either spontaneously or with the aid of massage and antibiotic drops in 80%–95% of patients.[1–5] Probing is very effective in patients with persistent congenital nasolacrimal duct obstruction, if it is performed before the patient is 13 months of age, with a success rate of 97%.[6] However, the success rate of probing decreases after 12 months of age. Katowitz and Welch[6] found the success rate to be 76.4% when probing is performed on patients from age 13 to 18 months, and 33.3% in patients over 24 months of age. Other studies have confirmed that the success of probing decreases with age, but the rate of decrease has varied significantly among different reports.[7–10] The different success rates for probing reported in the literature can be attributed to criteria for success, ranging from confirmation by telephone interviews to confirmation by examinations with or without fluorescein dye disappearance testing, time of follow-up, and variation of referral patterns.[6]

In addition to the decreasing success rate in older children, probing is much less effective in children with stenoses, obstructions, or diffuse narrowing of the nasolacrimal duct proximal to the level of the valve of Hasner.[11–13] Older children and children who have failed probing often have more proximal stenoses or obstructions of the nasolacrimal duct that can be the result of chronic infection and fibrosis or that may be congenital.[11,14] Paul and Shepherd[3] believe that children with congenital nasolacrimal duct obstruction proximal to the level of the valve of Hasner fail conservative treatment and therefore represent a higher proportion of older children.

Silicone intubation of the lacrimal drainage system has been used for children who fail probing or are older. Silicone intubation has a good success rate, but has significant drawbacks: the tube must be retrieved in the nose – this can be difficult in some patients; the tube must be removed 3–6 months after surgery, requiring a second

procedure; the child may remove the tube prematurely; and elongation of the puncta ("cheese wiring") can occur because of medial tension.[15,16]

Unlike probing or silicone intubation, balloon catheter dilatation of the nasolacrimal duct (DCP) achieves true dilatation. Furthermore, balloon catheter DCP is technically much easier to perform than silicone intubation, and obviates the need to remove the tube or concerns about the child removing the tube. A very high success rate can be achieved. One study of balloon catheter DCP of 61 lacrimal systems in 51 patients with congenital nasolacrimal duct obstruction (age range from 13 to 73 months, mean 26 months) showed a patency rate of 95%.[17] Of the patients treated in this series, 44.3% had no previous procedures, 34.4% had one or more failed probings, and 21.3% had failed silicone intubation. Other studies have also found balloon catheter DCP to be effective in children with nasolacrimal duct obstruction who have failed probing, have obstructions proximal to the valve of Hasner, or who are 13–24 months of age or older at the time of the primary intervention.[18–21]

The indications for balloon catheter DCP in congenital nasolacrimal duct obstruction are:

1. Failed probing at any age
2. Failed silicone intubation at any age
3. As a primary procedure in children older than 12 months of age
4. As a primary procedure in children with trisomy 21 at any age.[22] Children with trisomy 21 have a very poor response to probing or silicone intubation.[22]

Silicone intubation should be reserved for patients with canalicular stenosis, or used in combination with balloon catheter DCP for patients who have failed a primary balloon catheter dilatation.

Some physicians believe that probing should be performed after 1 year of age, or in older children if intraoperative findings indicate that a membrane at the level of the valve of Hasner is the only site of obstruction.[12,13] Balloon catheter DCP has a higher success rate than either probing or silicone intubation, and is least likely to lead to recurrence necessitating a second procedure and anesthesia. Balloon catheter DCP is therefore recommended for all children who meet any of the above four criteria, although each physician must decide on a case-by-case basis when probing should no longer be performed.

Before and after balloon catheter DCP, a medical regimen helps to ensure the greatest possible success rate. *It is essential that infection be eliminated or markedly suppressed before surgery.* Because antibiotic drops are unreliable and often inadequate, *administration of systemic antibiotics* for 7–10 days before surgery is imperative: amoxicillin and clavulanate potassium (Augmentin; total of 40 mg/kg/day in two divided doses) or cefaclor (total of 40 mg/kg/day in three divided doses). If the infection has not resolved or has not been markedly suppressed before balloon catheter DCP, surgery should be rescheduled. Preoperative cultures are not routinely performed, but cultures can be helpful if there is marked discharge. The most common organism cultured from patients with

congenital nasolacrimal duct obstruction and dacryocystitis is *Streptococcus pneumoniae*, although other organisms may be causative.[17,23]

In the operating room just before surgery, intravenous cefazolin (25 mg/kg) is administered. To allow time for vasoconstriction, the nose is packed with one 1/2 × 3 inch neurosurgical cottonoid soaked in 0.25% phenylephrine solution (available as a nasal spray) immediately after the administration of general anesthesia. The cottonoid is grasped along its long axis with a bayonet forceps, and is placed in the nasal cavity along the floor of the nose. In this position, it will contact the inferior turbinate and cause vasoconstriction. The surgical field is then prepped and draped.

The puncta are gently dilated. The cottonoid nasal pack is removed. The 0 or 00 Bowman probe is used to perform probing in the usual manner: placing the probe through the punctum and canaliculus into the lacrimal sac, orienting it vertically, pushing the probe down the nasolacrimal duct into the nasal cavity. It is essential to confirm that the probe has entered the nasal cavity because patients who are older or who have failed probing may have multiple stenoses or obstructions. The surgeon must be sure that the probe has penetrated all obstructions and entered the nose. Touching the probe in the nose with a metal instrument (e.g., another probe or closed mosquito hemostat) and feeling "metal on metal" helps confirm that the probe extends into the nasal cavity. The probe is then removed.

If the inferior turbinate appears tightly apposed to the lateral nasal wall, infracture of the inferior turbinate can be performed before balloon catheter inflation. Infracture of the inferior turbinate did not influence the success rate in Becker's series of 61 lacrimal systems, and is probably not essential.[17] Endoscopic visualization shows that there is usually a gap between the opening of the nasolacrimal duct and the inferior turbinate, even if the anterior inferior turbinate abuts the lateral nasal wall. If infracture is performed, a number 4 Penfield dissector or Freer elevator (both available in all operating rooms) is placed along the floor of the nose 25 mm into the nasal cavity. The curved end of the instrument is then slid along the nasal floor onto the lateral wall with the concavity of the instrument directed toward the lateral nasal wall. The instrument will thus lie between the lateral nasal wall and the inferior turbinate. At this point, the elevator is pushed medially to infracture the inferior turbinate medially (Figures 16.1 and 16.2).

After the probing segment of the procedure is completed, the balloon catheter can be placed. The technique of placing the balloon catheter is precisely the same as that used for probing. The lacrimal balloon catheter is in effect a balloon on a probe – handling and feeling like a Bowman probe and thus enabling any physician experienced with probing to accomplish balloon catheter DCP.

A 2-mm balloon catheter is used for patients 30 months of age or younger, and a 3-mm balloon catheter is used for patients older than 30 months of age. The deflated balloon catheter is pushed through the canaliculus, lacrimal sac, and down the nasolacrimal duct into the nose. The balloon catheter must be pushed all the way to the nasal floor, and confirmation of proper placement by touching the deflated

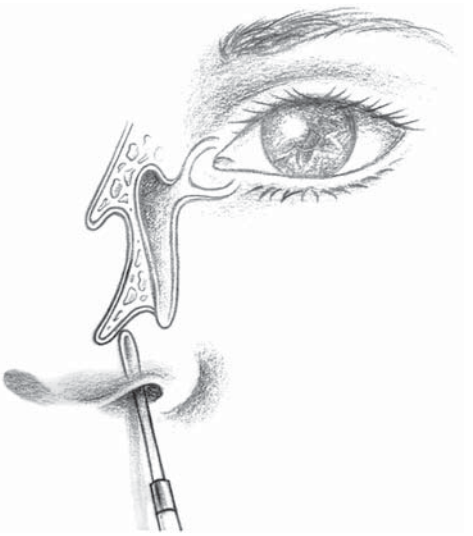

FIGURE 16.1. Infracture of the inferior turbinate (coronal view). The Freer elevator is in the inferior meatus, and is pushing the inferior turbinate medially.

balloon with another instrument is necessary. As mentioned earlier, multiple obstructions may be present, or the balloon may catch on an unusually thick valve of Hasner and stretch the mucosa of the valve without actually entering the nasal cavity. The balloon may be visualized in the nose with a sinuscope, but the use of an endoscope is optional.

Once the lacrimal balloon catheter is positioned in the lacrimal system, it can be connected to the inflation device. Any cardiac balloon angioplasty inflation device can be used, and is obtained from the hospital cardiac catheterization laboratory. Alternatively, the inflation device can be obtained from the same company that makes the lacri-

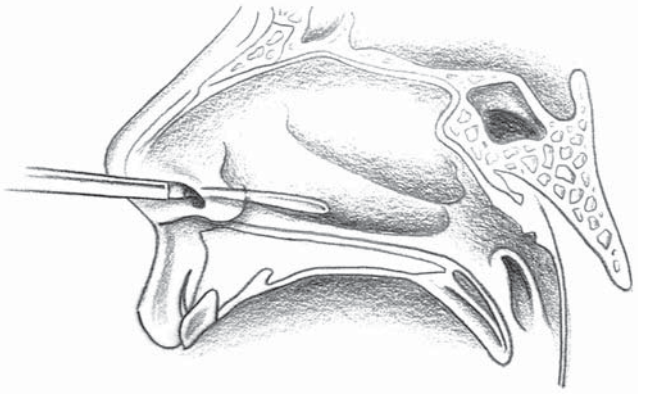

FIGURE 16.2. Infracture of the inferior turbinate (sagittal view).

mal balloon catheter (Atrion, Quest Medical, Allen, TX). Inflation is performed twice for 20 seconds each at a pressure of 8 atmospheres (Figure 16.3). This dilates the distal nasolacrimal duct.

The balloon catheter is then deflated and pulled more proximally so that it lies within the lacrimal sac and proximal nasolacrimal duct. The proximal nasolacrimal duct including the sac–duct junction will thus be dilated. This is essential because an obstruction at the sac–duct junction is present in some older patients or in those who have failed probing.[15] The proximal catheter shaft has a mark 10 mm proximal to the beginning of the working (full diameter) portion of the balloon, and a second mark 15 mm proximal to the beginning of the working portion of the balloon. The punctum is aligned at a point 5 mm distal to the 10-mm mark (i.e., the punctum is 5 mm from the balloon). This ensures that the proximal balloon is in the lacrimal sac. An accordion-like contraction of the canaliculus caused by the balloon catheter causes the punctum to be very close to the lacrimal sac. If the balloon catheter is in the common canaliculus, it will slither into the lacrimal sac at the onset of dilation. Inflation is performed to 8 atmospheres of pressure and is again performed twice for 20 seconds (Figure 16.4). After the proximal dilation, the balloon catheter is deflated, all residual fluid is aspirated with a syringe, and the catheter is withdrawn from the lacrimal system. The balloon will not completely deflate passively, and so it is necessary to aspirate the fluid out with a syringe.

Fluorescein-stained fluid is then irrigated through the lacrimal system and recovered in the nose with a soft suction catheter. The fluid should irrigate easily and profusely through the lacrimal system. If not, dilation should be performed again.

Fourth-generation fluoroquinolone drops and 1% prednisolone drops are administered four times a day for 10 days after surgery. The systemic antibiotics are continued for 5 postoperative days.

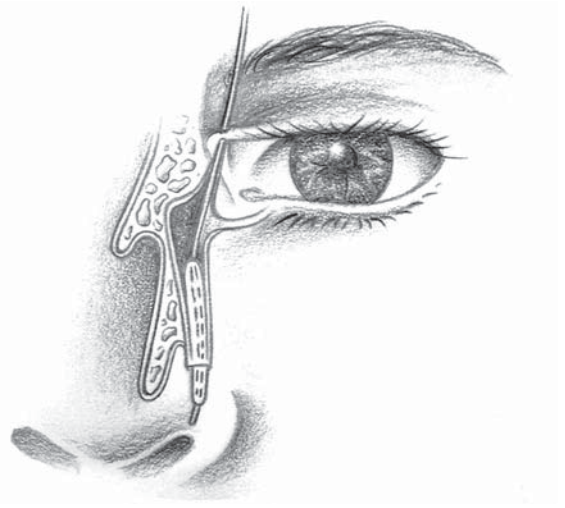

FIGURE 16.3. The lacrimal balloon catheter has been pushed to the nasal floor and inflated.

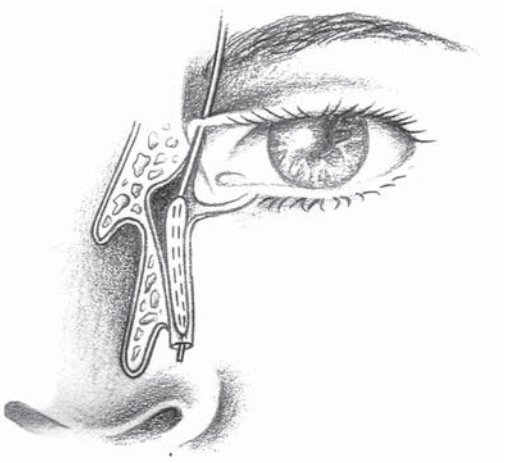

FIGURE 16.4. The lacrimal balloon catheter has been pulled proximally. The balloon lies in the lacrimal sac and extends into the nasolacrimal duct.

Although many physicians are not comfortable with the use of systemic corticosteroids, and good results can be achieved without their use, the author recommends administration of 4 mg of dexamethasone intravenously at the beginning of surgery, prednisolone (15 mg/5 cc) 15 mg a day for 2 days after surgery, then 7.5 mg a day for 2 days. Corticosteroids reduce edema, fibroblast activity, and possibly fibrosis after surgery, but a controlled study has not been performed to determine the efficacy of this and other elements of the medical regimen described here.

Patients are examined at 1 day, 2 weeks, and 6 weeks after balloon catheter DCP to confirm continuing patency of the lacrimal drainage system.

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