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Surgery of the Punctum and Canaliculus

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Some diseases of the punctum and canaliculus can be treated medically, but many require surgical intervention. In this chapter, different surgical techniques involving the punctum and canaliculus are reviewed.[1–7]

Dilation, Probing, and Intubation

The lacrimal drainage system can be obstructed anywhere along its pathway. An obstruction can range from partial blockage or stenosis to complete atresia or anatomic absence of a structure. The anatomic details of the lacrimal system have been described in Chapter 1.

The most common indication for lacrimal probing is epiphora. Probing in children with congenital nasolacrimal obstruction is a delicate procedure. Probing can be performed in an office setting; however, the majority of ophthalmologists perform pediatric nasolacrimal probings in an ambulatory surgery setting with heavy sedation or general anesthesia. Adults can be probed in the office with only topical anesthesia and, occasionally, with a small amount of local or regional anesthetic blocks.

In preparation for the probing, a nasal decongestant/vasoconstrictor (e.g., oxymetazoline or 2.5% phenylephrine) should be placed in the nostril on the side of the probing. This can be accomplished by placing presoaked neurosurgical cottonoids or cotton-tipped applicators in the nose under the inferior turbinate in the region of the valve of Hasner. The surgeon allows a few minutes for the nasal mucosa to shrink. If the procedure is done in the office, a topical anesthetic drop should be instilled in the eye before probing. When attempting to probe, the surgeon should remember that the upper system begins vertically at each punctum followed by a 2-mm dilated vertical segment (the ampulla) followed by an 8-mm horizontal segment (the canaliculus).

Dilation

Punctal dilation can be performed first in order to safely introduce a lacrimal probe. The smallest-tipped punctal dilator is placed vertically

for the 2-mm distance and is turned horizontally. The dilator is gently pushed medially to dilate the punctum. Too much force can cause a mucosal tear in the ampulla or the canaliculus.

Probing

A small Bowman probe, preferably a number "00" or "0," is inserted into the inferior or superior punctum. The probe is passed 2 mm vertically then medially and slightly superiorly while countertraction is held on the lid. Once the surgeon reaches the lacrimal sac, the lacrimal bone or a "hard stop" will be felt through the mucosa. The probe is rotated so that the tip points inferiorly, slightly laterally and slightly posteriorly before entering the nasolacrimal duct. To obtain proper orientation, the surgeon can align the top of the probe with the supraorbital notch or supraorbital foramen. The surgeon should avoid using significant force, although some resistance may be encountered. Use of excessive force could result in creation of a false passage. Resistance is typically encountered as the probe passes into the bony canal, and at the distal end of the duct as it passes through the obstructed valve of Hasner or rubs against the inferior turbinate. In children, the distance between the punctum and the floor of the nose is 20–25 mm and in adults it is 30–35 mm.

While inserting a nasal speculum into the nose, the surgeon directs a larger Bowman probe laterally under the inferior turbinate until the two probes touch and "metal-on-metal" is felt or heard. If there is difficulty identifying the lacrimal probe under the inferior turbinate, the inferior turbinate can be infractured using a periosteal elevator. When the procedure has been completed, fluorescein-tinted saline should be irrigated through the canaliculus and recovered from the nose using a suction tip to confirm patency of the system.

Intubation

Silicone intubation is used to provide a stent through the lacrimal apparatus in order to maintain patency. The stent is typically left in place for a predetermined amount of time. It is frequently performed in children who have had repeated probings. Other uses for silicone intubation are in primary cases in older children more than 12 months of age or when significant strictures are noted during primary probing. There are a number of commercially available silicone intubation systems.

The Crawford tubes have an olive-shaped tip on the ends of their two stainless steel probes to which the silicone tubing is attached. The tip is engaged by a retrieval hook and pulled out through the nose. The Crawford tubing is factory glued to metal probes and should not pull apart during intubation. The Crawford tubing sets come with and without an intraluminal 8-0 silk suture for tying the ends of the silicone tubing together.

The Ritleng probe is fashioned with a Prolene thread that lies between the silicone tube and a probe that is similarly engaged with a hook and

pulled through the nose. There are a few probes (e.g., Guibor, Quickert-Dryden) that are removed from the nose either with the use of a grooved director or using a long narrow hemostat under direct visualization. These probes are either attached to or lie within the silicone tubing.

Retrieval of the metal probe from the nose can be aided by bending the probe 15 degrees at its distal third. The probe can be lubricated with an antibiotic ophthalmic ointment and passed vertically through the lower punctum into the lower canalicular system. The lower lid is pulled to avoid kinking of the canaliculus, and the probe is rotated 90 degrees so that it is in the horizontal plane. It is advanced nasally until it enters the lacrimal sac and the lacrimal bone and fossa are encountered. It is rotated 90 degrees vertically, angled 15 degrees posteriorly, and advanced down the nasolacrimal duct. The probe exits from under the inferior turbinate usually at the junction of the anterior and middle thirds of the undersurface of the turbinate. A retrieval hook is inserted laterally under the inferior turbinate with the hook tip preferably oriented vertically.

When metal-on-metal is heard or felt, the hook is rotated against the probe to engage the olive tip, if using the Crawford tubes. The probe is slowly retracted until the hook and olive tip are engaged. The hook is used to pull the probe out of the nose. After successful intubation of both canaliculi, the metal probes are removed from the ends of the tube and the silicone tubing is tied together in multiple knots to secure the silicone tube as a single loop within the nose. The tube can then be anchored to the lateral mucocutaneous junction inside the ala using a 6-0 Prolene suture (Ethicon, Somerville, NJ) or left unattached.

Punctoplasty

The most common condition requiring punctoplasty is punctal stenosis. A one-snip punctoplasty is successful in the majority of cases. Topical anesthesia (e.g., 4% lidocaine, tetracaine, proparacaine) on a cotton-tipped applicator applied directly to the punctum, or a local injection with 2% lidocaine infiltrated near the punctum can be used to obtain anesthesia. In cases where there is complete punctal stenosis or atresia, a sharp probe or needle may be used to initiate a small opening. This small opening should then be dilated and a lacrimal probe passed to assure a connection to the lumen of the canaliculus. In cases without complete stenosis, the punctum should also be dilated with a punctal dilator.

The punctum is secured by gently grasping the lid margin just lateral to the punctum with toothed forceps. Using Westcott scissors, the surgeon completes a one-snip punctoplasty on the posterior surface of the ampulla. The scissors are held perpendicular to the lid margin with one blade of the scissors inserted into the dilated punctum and ampulla while the other blade is left outside the ampulla on the conjunctival surface. A single vertical snip approximately

2–3 mm long is made along the conjunctival surface in the vertical canaliculus. Once this is performed, gentle redilation of the punctoplasty with a lubricated dilator will help ensure healing in a patent position.

Two-snip and three-snip punctoplasty procedures have been described. In the two-snip procedure, two connecting strips are made along the conjunctival side of the punctum and a triangular wedge is excised. This procedure, however, offers little advantage over the one-snip procedure. Three-snip procedures are advocated less often because of their potential for destruction to the lacrimal outflow apparatus. Essentially, two vertical snips are made along the punctum with a third horizontal snip connecting the two vertical snips at their base.

If stenosis recurs after punctoplasty, a repeat one-snip punctoplasty should be combined with silicone intubation.

Punctal Ectropion

Repairs of involutional, noncicatricial, punctal ectropia are performed to rotate the punctum posteriorly into the lacrimal lake. Local anesthesia, composed of 2% lidocaine with epinephrine 1:100,000 injected transconjunctivally into the medial aspect of the lower lid both lateral and inferior to the punctum, is required. Subcutaneous injection on the anterior surface of the ampulla is recommended. With the lower lid retracted outward, the conjunctiva is dried with a cotton-tipped applicator and a diamond pattern is marked with the apex 3–4 mm below the punctum, measuring 4 mm vertically and 6–8 mm horizontally. To protect the canaliculus, a lacrimal probe can be inserted. The conjunctiva and subconjunctival tissue are excised. Double-armed 5-0 absorbable sutures are used to close the defect. The first needle is passed through conjunctiva and deep tissue above the spindle, exiting within the wound. The needle is then regrasped and passed full-thickness through the center of the wound and out through the skin. The other suture is then passed in a similar manner but through the lower edge of the wound. A single stitch is all that is required, although more sutures can be used, depending on the horizontal length of the spindle. As the sutures are tied externally on the skin without bolsters, the punctum should turn in toward the globe.

Canalicular Surgery

Lacerations

In canalicular lacerations, repair of a lacerated lower canaliculus is imperative for the prevention of chronic posttraumatic epiphora. The repair of upper canalicular lacerations, although not as critical for the prevention of posttraumatic epiphora, should be performed, if possible. Repair should be performed within the first 24–48 hours after injury, preferably within the first 24 hours. Regional blocks (e.g., infraorbital

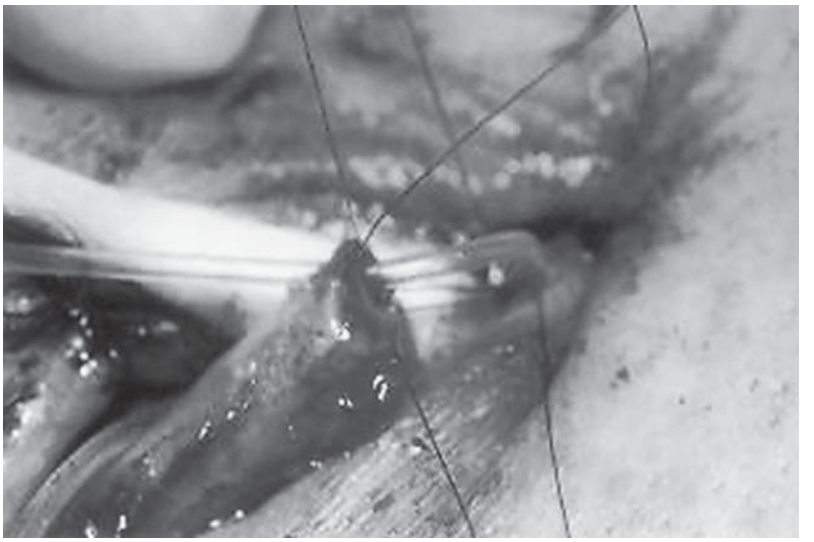

FIGURE 9.1. Repair of a lid margin laceration involving the canaliculus.

or infratrochlear) can offer superior anesthesia without distortion of the traumatized tissues.

If possible, canalicular lacerations should be probed before repair in the operating room to assure disruption of the lacrimal apparatus. Tetanus immune status should be achieved and treated appropriately. Preoperative treatment with intravenous antibiotics for contaminated wounds should be considered. The nose should be prepared for possible intubation by decongesting it with topical phenylephrine or other nasal decongestants (e.g., oxymetazoline). If general anesthesia is not given, the nasal mucosa should be anesthetized (e.g., topical lidocaine or cocaine). The surgeon must thoroughly irrigate the wound. Internal splinting of the canaliculus is mandatory to repair the laceration, and there are several materials that may be used successfully. End-to-end anastomosis of the canaliculi can be achieved using two or three 7-0 or 8-0 absorbable sutures placed equidistant around the wound edges (Figure 9.1).

Many methods and a variety of materials have been described for stenting a lacerated canaliculus (e.g., metal rods, polyethylene tubes, absorbable sutures, etc.). When silicone stents were introduced, they rapidly became the material of choice.

Monocanalicular Intubation

Monocanalicular stenting can be accomplished using the Mini Monoka (FCI Ophthalmics, Marshfield Hills, MA) monocanalicular intubation set. This hollow silicone tubing (40 mm) is attached to a patent silicone plug. Once in place, it offers a pathway for escape of tears while the repaired laceration heals. When a monocanalicular stent is used, the opposing canaliculus does not have to be violated and usually the nose does not need to be entered.

The surgeon passes the Mini Monoka stent through the punctum and distal canaliculus into the laceration and then pushes it into the proximal end of the canaliculus and the nasolacrimal canal. The pericanalicular tissue is then reapproximated using interrupted 7-0 absorbable sutures (e.g., Vicryl or chromic sutures), one inferior and one superior to the canaliculus if there is minimal tension on the wound. In cases in which significant tension exists, 5-0 Vicryl or chromic gut should be used to close the deep subcutaneous tissue first.

Before closing the deep tissue, the medial canthal tendon should be evaluated and, if the tendon is involved in the laceration, 5-0 Vicryl suture on a small half-circle needle (P-2) should be used to reapproximate it to the periosteum above the lacrimal crest. If both ends of the cut tendon are visible, it can be attached to itself. The distal end of the stent with the cap is designed to fit snugly into the punctum and ampulla and no stitch should be required (Figure 9.2). The stent is left in place for several weeks while the canaliculus heals. Although the Mini Monoka is the authors' preferred stent, standard silicone tubing can be used. The distal end of the tubing is tied into a knot to prevent it from slipping into the canaliculus and sutured to the eyelid skin near the lash line.

Bicanalicular stenting can be used to repair monocanalicular lacerations. This is useful when the laceration involves the papilla or ampulla. Because the authors have had such good results with the Mini Monoka monocanalicular stent, they reserve bicanalicular stenting for bicanalicular lacerations.

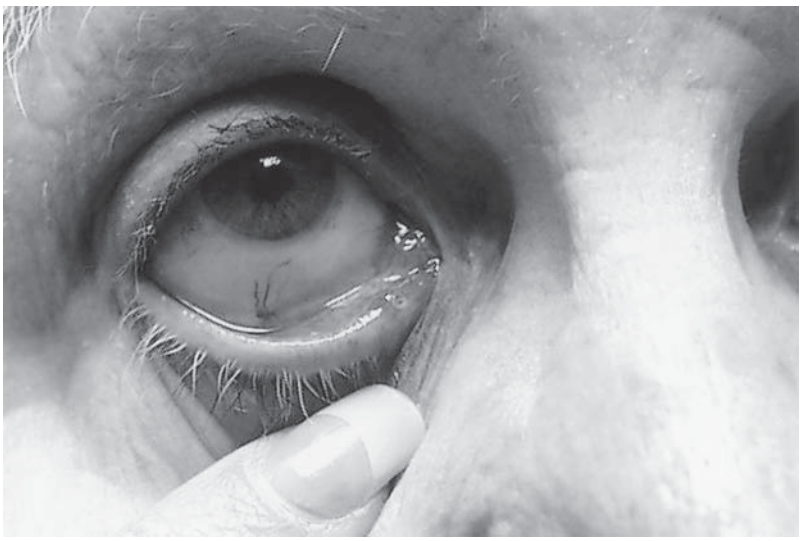

FIGURE 9.2. Well-seated Mini Monoka flange in right lower eyelid punctum.

Bicanalicular Intubation

There are a variety of bicanalicular lacrimal intubation systems [e.g., Crawford, Ritleng FCI Ophthalmics (Marshfield Hills, MA), BD Visitec (Franklin Lakes, NJ)]. Each contains a length of silicone tubing that is fixed to rigid or semirigid probes, one at each end of the tubing. Most have a retrieval instrument (e.g., hook or guide) that is used to remove the tubing from the nose.

Once the distal and proximal ends of the lacerated canaliculus are found, one probe is inserted through the punctum, into the wound, and out the distal end of the lacerated canaliculus. The tissue around the proximal end of the lacerated canaliculus is gently supported while providing countertraction; the same probe is continued through the open end of the proximal canaliculus. The probe is directed in the usual manner through the nasolacrimal sac and canal and into the nose. The appropriate retrieval instrument is used to remove the probe from the nose. The canaliculus is repaired over the tubing as described above (Figures 9.3 and 9.4). The same process is repeated for the opposite canaliculus.

The silicone tubing is tied to itself with multiple knots once the Crawford probes are removed. The silicone tubing can be anchored to the mucocutaneous junction inside the lateral nasal wall with 6-0 Prolene suture. If a combined upper and lower canalicular laceration is present that cannot be reanastomosed or if the medial end of the canaliculus is too damaged to allow identification, a standard dacryocystorhinostomy dissection can then be executed opening the

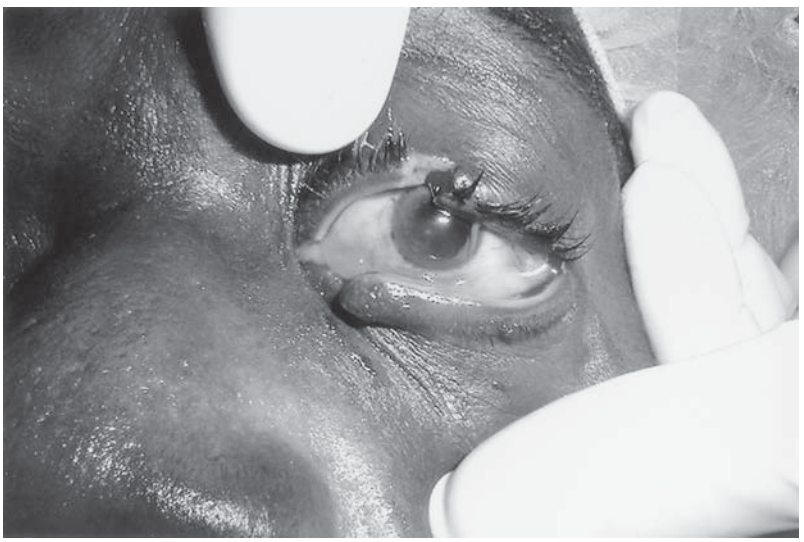

FIGURE 9.3. Upper and lower eyelid lacerations involving the left lower eyelid canaliculus.

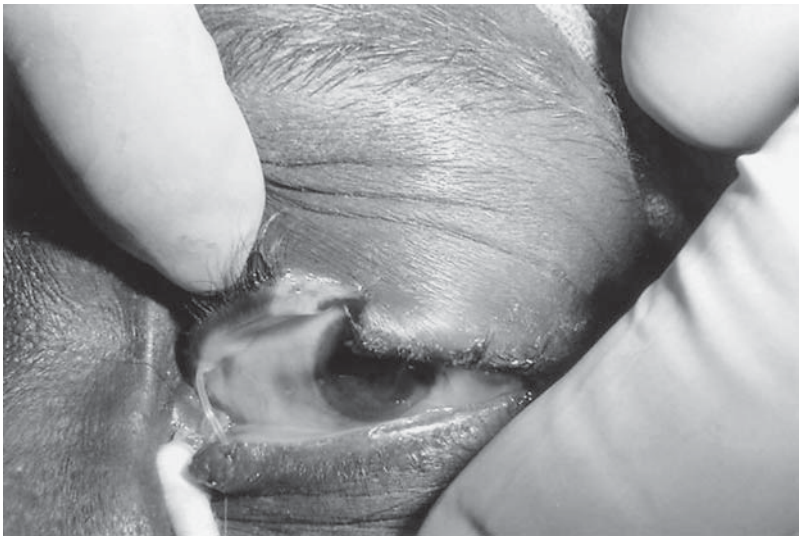

FIGURE 9.4. Same patient in Figure 9.3 after bicanalicular intubation.

lacrimal sac vertically. The lacrimal probes can then be guided into the lacrimal sac through the soft tissue after the common internal punctum has been enlarged. An absorbable 5-0 suture (e.g., Vicryl or chromic) is used to close the sac and the skin is closed in the standard manner. If this is not possible and the extent of the damage is too great or appears irreparable, it is acceptable to repair the laceration and return at a later date for Jones tube placement or a standard dacryocystorhinostomy.

Canaliculotomy

The most common organism responsible for causing canaliculitis is *Actinomyces israelii*. Concretions, which may be up to 5 mm in diameter, develop in the canaliculus (Figure 9.5). Several methods of treatment are available. The least invasive is removal of the stones with a 2-mm curette through a dilated punctum. If that is not sufficient, the surgeon may make a horizontal incision through the posterior lid, curette out the stones, and repair the wound.

Our preferred method is to pass a probe into the canaliculus and make a horizontal incision through the skin to open the canaliculus and expose the probe. The incision should begin about 2 mm medial to the ampulla and be about 8 mm in length. Once the canaliculus is opened, the probe is removed and the stones are extracted with a small curette. The canaliculus may be irrigated with antibiotic solution. A silicone tubing stent such as a Mini Monoka is passed into the canaliculus and the wound is closed with small absorbable sutures. The tube is removed in a few weeks.

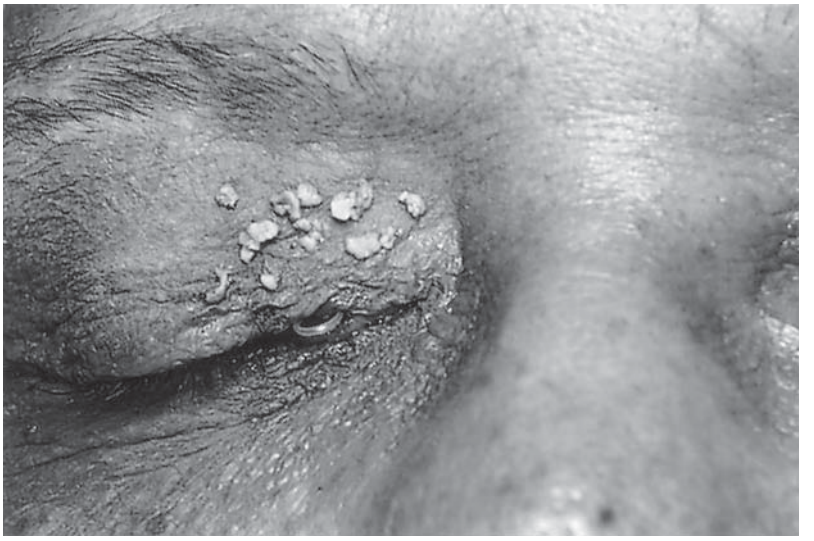

FIGURE 9.5. Canalicular concretions secondary to a canaliculitis.

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