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Primary Endonasal Dacryocystorhinostomy

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External dacryocystorhinostomy (DCR) has been the procedure of choice for many decades to treat nasolacrimal duct obstruction. The procedure, first described by Toti[1] at the turn of the twentieth century, has been refined over the years and is still currently adopted by most ophthalmologists. It consistently yields excellent results and can be routinely done under local anesthesia on an outpatient basis using minimal instrumentation. The intranasal approach to lacrimal surgery was first described by Caldwell[2] in 1893; however, it quickly fell out of favor because of difficulties viewing the intranasal anatomy through the nose. Attention returned to the intranasal approach after Heermann[3] in 1958 introduced a direct technique for endonasal lacrimal surgery using an operating microscope that produced very good results.[4] Routine utilization of endoscopes by ears, nose, and throat surgeons led to renewed interest in approaching the lacrimal duct from the nose. The first modern endonasal DCR procedures using endoscopes were described by McDonogh and Meiring[5] in 1989. Especially in America, early endonasal DCR techniques frequently included the use of lasers to burn through the mucosa and create the osteotomy.[6] However, the laser-assisted endonasal DCR yielded inferior results compared with the external route. This was likely the result of the generation of excess granulation tissue and char around the ostium in the postoperative period.[7] Careful compliance to endoscopic surgical techniques with minimal tissue damage, the preservation of mucosa, and the creation of mucosal flaps has enabled this technique, in most cases, to become a positive alternative to external DCR with comparable outcomes.[8]

Endonasal DCR has significant advantages over external DCR. It avoids a skin incision and scar, especially important in younger individuals or in patients with a history of keloid formation. Dissection is limited to the inner wall of the lacrimal fossa, leaving intact the medial canthal anatomy and lacrimal pump function and avoiding a surgical site that goes from the skin to the nasal cavity. Postoperative pain is minimal, if at all present, and most patients can resume their normal activities a few days after surgery. The surgery requires less tissue

dissection, often resulting in less intraoperative bleeding and a shorter surgical time than external techniques.[9] Endonasal DCR can also be performed early to manage definitively acute dacryocystitis with abscess formation, minimizing the need to decompress the sac from the skin side.[10]

There are also limitations. An anterior diverticulum arising from the lacrimal sac may not be effectively managed via the endonasal approach. Patients with a history of midfacial trauma may have altered anatomy involving the bones surrounding the lacrimal sac, making endonasal DCR hazardous with less predictable outcome. A lacrimal sac neoplasm is best treated with an external DCR. Finally, there is a steep learning curve with using the nasal endoscope that may hamper early success if proper training has not been obtained.[9]

Patient Selection

The most frequent indication for endonasal DCR is chronic epiphora caused by acquired dacryostenosis. Other indications include acute or chronic dacryocystitis with or without the presence of a dacryolith. The technique is useful in children with recurrent dacryostenosis despite probing and lacrimal intubation. In addition, endonasal DCR has produced good results in patients with functional nasolacrimal duct obstruction as determined by dacryocystography and lacrimal scintigraphy.[11]

The investigation of the lacrimal system begins with the examination of the punctum to exclude agenesis, stenosis, ectropion, or any other abnormality. The medial canthal area is palpated to look for any firm mass that might represent a mucocele, dacryolith, or a tumor. If tumor is suspected or there is a history of midfacial trauma, further evaluation with computed tomography scan and/or bone subtraction dacryocystography is necessary. Lacrimal system irrigation will confirm obstruction and allows the assessment of the common canaliculus and internal punctum because exploration of the common canaliculus cannot be performed easily during endonasal DCR.

Careful evaluation of the nasal cavity using an endoscope is crucial to assess the nasal access to the lacrimal sac. A large medial turbinate, nasal polyps, granular inflamed mucosa, tight nostrils, and septal deviations are all potential problems that can make endonasal DCR more difficult or impossible.

Preparation of the Nose

Preoperative vasoconstriction of the nasal cavity using a long-acting nasal decongestant 2 hours and 1 hour before the operation helps visualization and minimizes intraoperative bleeding. Patients with seasonal allergies or with upper respiratory tract infections should wait for remission of their nasal congestion before having surgery. In cases of severe septal deviations, corrective surgery may be necessary before lacrimal surgery, either as a combined procedure or as a separate operation. However, in those patients with septal anomalies or tight

nostrils, an external DCR is an excellent option that should be considered in most cases.

Anesthesia

Endonasal DCR can be performed safely under local or general anesthesia. Conditions favoring general anesthetic include acute dacryocystitis, prior surgery in the lacrimal area, difficult nasal anatomy with a tight access, and patient preference. However, in experienced hands and a normal nasal anatomy, local anesthesia can be offered, making the procedure particularly suitable to an ambulatory care unit without a full recovery room.

In both types of anesthesia, the lateral wall of the nose and middle turbinate are infiltrated with a solution of lidocaine 2% with epinephrine 1:100,000 and the nostril is then packed with gauze soaked in either 5% cocaine or a solution of neosynephrine 0.25%–lidocaine 3%. This induces long-lasting vasoconstriction and decongestion of the nasal mucosa allowing optimal visualization and minimizing bleeding. With local anesthesia, an anterior ethmoidal block from the orbital side along the medial orbital wall, 1–1.5 cm behind the medial canthal tendon, provides deep anesthesia of the sac area, the anterior ethmoids, and surrounding bones. The superficial tissues around the medial aspects of the lids should also be infiltrated and the cornea anesthetized with topical eyedrops.

Surgical Equipment

It is mandatory when performing nasal endoscopic procedures to use proper high-quality instruments. A 4-mm, 0-degree endoscope is the instrument most often used, although a 30-degree tip is useful for certain situations in which an oblique view is necessary. A high-powered light source (Xenon) is essential to keep visualization at an optimal level. A high-resolution monitor at least 19 inches wide should be placed at the head of the patient and at eye level of the surgeon. A secondary light source is also necessary to transilluminate the lacrimal sac with a fiberoptic probe.

Surgical Technique

The puncta are dilated and the fiberoptic probe is gently inserted through the upper canaliculus and passed through the internal punctum into the lacrimal sac. The light probe will transilluminate the lacrimal sac through the thin lacrimal bone. The thicker frontal process of the maxilla does not transilluminate as well so that the anterior part of the transillumination corresponds to the lacrimal suture line. The position of the middle turbinate should be appreciated in relation to the position of the sac.

In some cases, the middle turbinate may be displaced medially using a Freer elevator to enhance exposure to the lateral nasal wall over the

lacrimal area. A small ridge formed by the projection of the frontal process of the maxilla can usually be seen. A mucosal incision is made with a crescent blade or the sharp edge of the Freer elevator just anterior to that ridge below the insertion of the turbinate (Figure 12.1). The incision is extended inferiorly for 10 mm and should go down to the bone and involve the mucoperiosteum. A Freer periosteal elevator is then used to elevate the nasal flap. To avoid damaging the mucosa, the Freer must be kept in continuous firm contact with maxillary bone while dissecting under the mucoperiosteum. Posterior incisions are then made at the superior and inferior margin of the mucosal flap using Yasargill scissors (Figure 12.2). Using the Freer elevator, the mucosal flap is elevated and displaced medially to the middle turbinate to expose the thin lacrimal bone and the area of transillumination. The thicker bone of the frontal process of the maxilla is anterior and does not transilluminate well. The suture line between the lacrimal bone and the frontal process of the maxilla is easily seen. The osteotomy is started by removing the frontal process of the maxilla with a 2-mm Kerrison rongeur (Figure 12.3). The lacrimal bone does not need to be removed at this stage. With the tip of the rongeur, the edge formed by the thick maxillary bone can be felt and the rongeur is inserted just under it, pushing the lacrimal bone toward the sac. Usually 5 to 6 bites are necessary to uncover the anterior part of the lacrimal cylinder. Care is taken to slip the instrument between the bone and the lacrimal mucosa to avoid undue bleeding and early opening of the sac. The posterior aspect of the lacrimal sac and duct is exposed by removing the lacrimal bone (Figure 12.4). Using a Freer elevator, the thin sheets of lacrimal bone are lifted carefully from the lacrimal mucosa and then removed with microethmoid forceps. When the sac is scarred and has a small lumen, a more superior osteotomy is required. This is more

FIGURE 12.1. Incision of the nasal mucosa with a crescent knife.

FIGURE 12.2. Inferior incision with scissors. The superior incision has been made.

easily done with a 45-degree tip Kerrison rongeur. Superiorly, the frontal process of the maxilla often has a more posterior projection and removal of the uncinate process may be necessary.

The lacrimal sac is then filled with a viscous solution of methylcellulose. The transillumination probe can be used to tent up the lacrimal sac. A straightened crescent knife is used to create a vertical incision in the anterior portion of the lacrimal cylinder. The incision is directed posteriorly at the superior and inferior end, allowing the large lacrimal

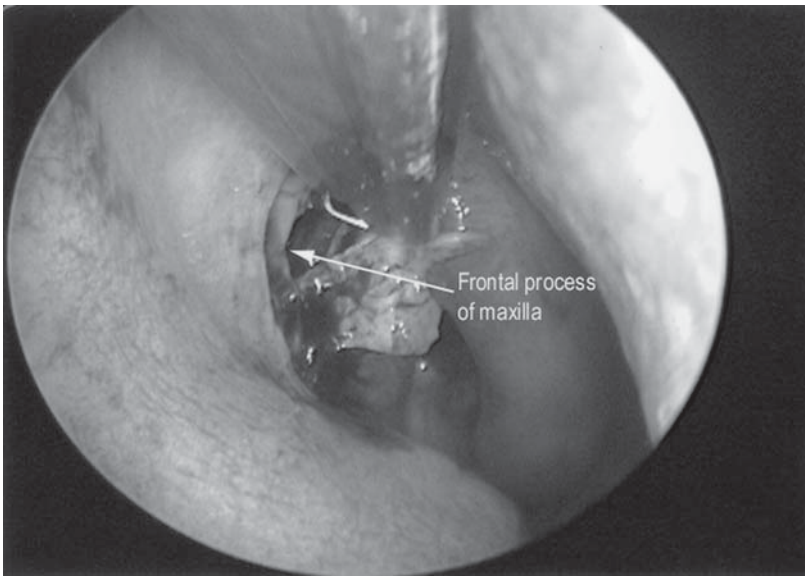

FIGURE 12.3. Osteotomy of the frontal process of the maxilla.

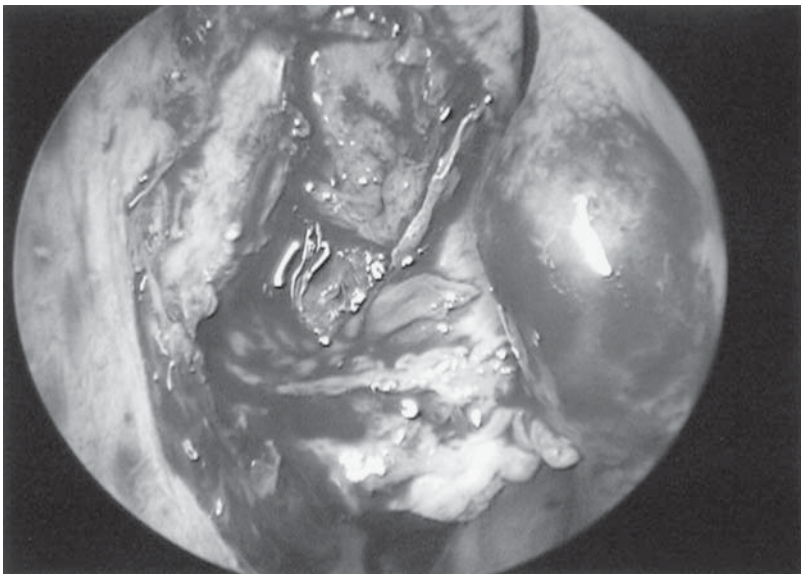

FIGURE 12.4. Lacrimal sac exposed after completion of osteotomy with light probe in the superior portion.

mucosal flap to be hinged posteriorly (Figure 12.5). Massage of the sac at the inner canthus allows for visualization of the fundus of the sac and removal of any dacryolith that may have caused obstruction. The lacrimal mucosa can also be biopsied and sent for histopathologic examination if it is thought to be abnormal.

A Freer elevator is used to mobilize the nasal mucosal flap laterally to come in contact with the posteriorly directed lacrimal sac flap (Figure 12.6). Having the flap edges in close apposition on the lateral nasal wall

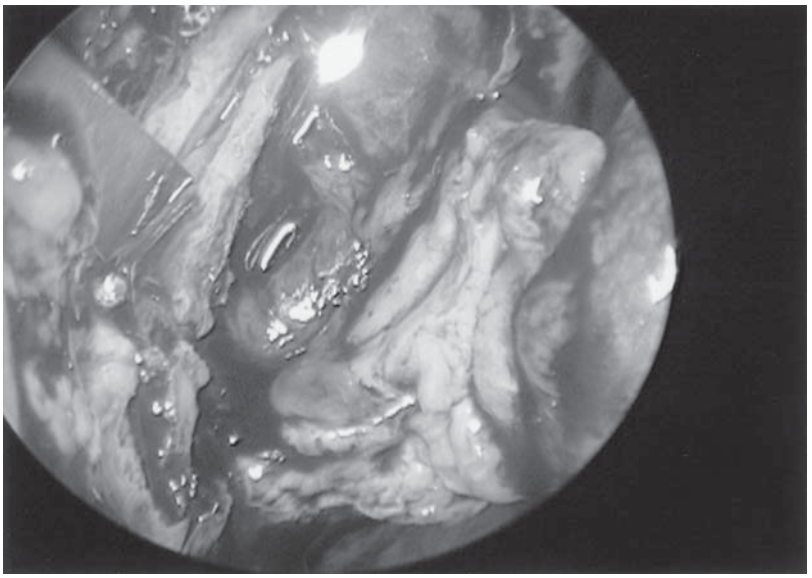

FIGURE 12.5. Incision of sac with light probe showing through in upper portion of the sac.

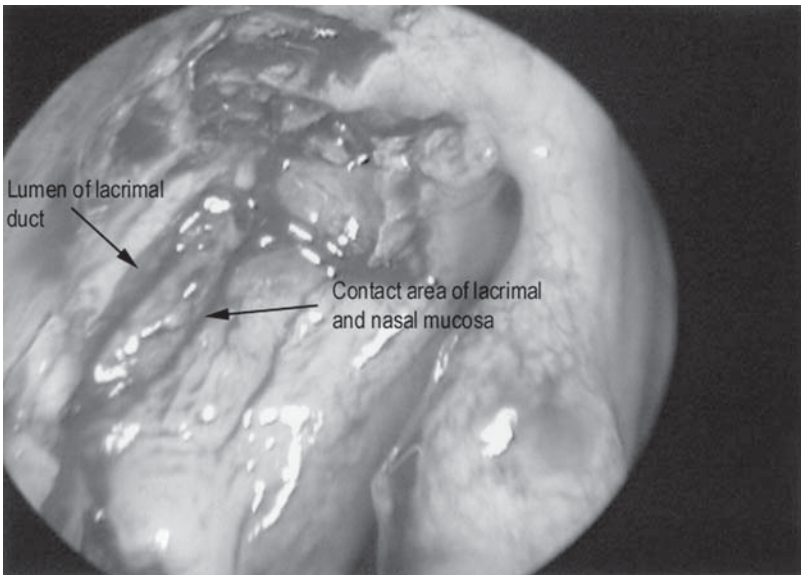

FIGURE 12.6. Apposition of lacrimal and nasal mucosal flaps.

allows for fusion of the mucosal flaps when healing, creating a mucosal-lined fistula from the sac to the nose.[12] This resembles flap creation in external DCR. At the end of surgery, bicanalicular intubation is done with silicone tubes and the ends are retrieved from the nose with straight microethmoid forceps. Lastly, a small piece of Gelfoam soaked in methylprednisolone 40 mg/cc is slipped over the tubes down on the mucosal flaps to stabilize them and encourage stabilization of the flaps in contact with each other (Figure 12.7).

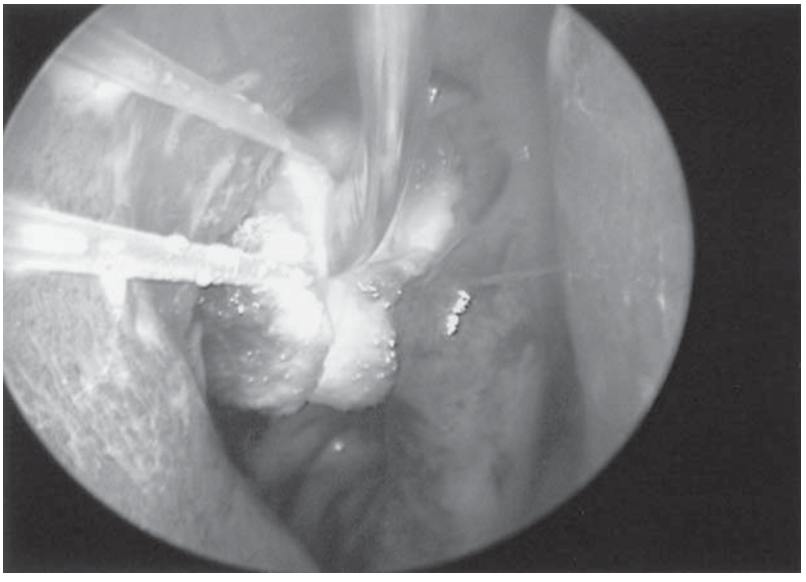

FIGURE 12.7. Gelfoam packing soaked in steroid solution and slipped over lacrimal silicone tubes.

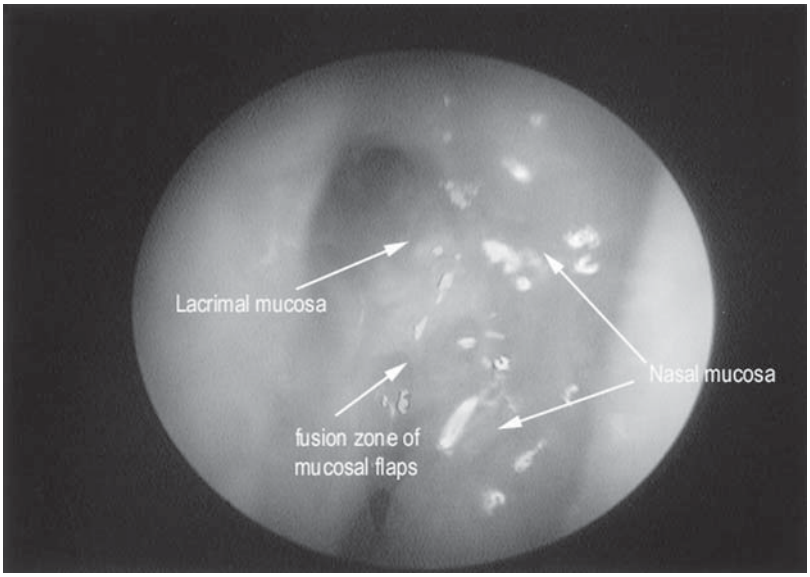

FIGURE 12.8. Endoscopic view 1 month after surgery. The silicone tubes had just been removed. The mucosal flaps were still swollen and hyperemic but the flaps were well fused and the lumen of the DCR clearly visible.

Postoperative Care

Patients are instructed to avoid nose-blowing for 10 days. Prophylactic systemic antibiotics are used only if significant infection is present. Washing of the nostril with saline sprayed in the nose is done for 1 week, 3 or 4 times daily. An antibiotic–steroid combination eyedrop is used for a week in the operated eye. The lacrimal system is irrigated at 1 week and at 1 month. The tube is removed at 1 month. Endoscopy can be performed at 1 week if cleaning of the nostril is believed to be necessary and at 1 month to confirm adequate healing of the surgical site (Figure 12.8). A final follow-up is done at 3 months to confirm the patency of the lacrimal passage and rehabilitation of the nasal anatomy (Figure 12.9).

Complications

Intraoperative or early postoperative bleeding is one of the chief concerns with endonasal DCR surgery. Prevention is the key and involves patients stopping systemic anticoagulants and adequate preoperative preparation to obtain maximum vasoconstriction of the nasal mucosa. Minimal bleeding during the operation is managed with suction. With moderate intraoperative bleeding, the area can be packed with neurosurgical sponges and the suction can be used as well to draw blood into the sponges, further drying the field. If profuse, uncontrollable bleeding occurs, obscuring visualization, the surgeon should consider

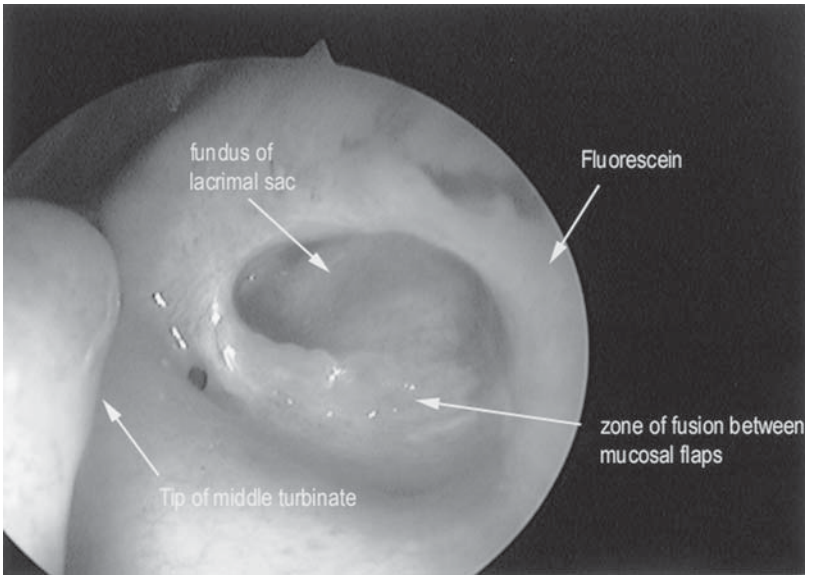

FIGURE 12.9. At 3 months, the dye test was frankly positive at 1 minute and the mucosa was now back to a normal appearance with good continuity of the mucosal flaps.

aborting the operation instead of pursuing the dissection blindly. In the rare instance when significant bleeding occurs in the early postoperative period, the nose is packed overnight and packing removed 24–36 hours later. Patients are given instructions to avoid aspirin-containing compounds and to avoid heavy exercise or Valsalva during the first 10 days after surgery.

Invading adjacent structures is a known complication of endoscopic nasal surgery. Confirming surgical landmarks at every step of the operation will prevent deep invasion of surrounding structures. Temporally, the orbit can be violated, leading to damage of the orbital fat or medial rectus and inferior oblique muscles.[13] A hemorrhage could also result from this complication and any hematoma under tension in the deep medial orbit should be considered for evacuation in extreme cases. Injury to the skull base should not be a risk as long as the proper landmarks are respected. The placement of the light probe in the sac determines the superior landmark, which should be at the level of the internal punctum. However, despite this measure, should a cerebrospinal fluid leak occur, the dissection should be stopped and the patient should be placed on the appropriate antibiotics prophylactically. Bed rest, and in some cases, a lumbar shunt may be necessary to collapse the leak.

Postoperative synechia between different structures in the nose can create problems.[14] The most frequent is a small adhesion between the tip of the middle turbinate and the lateral nasal wall in cases with tight nostrils. Allowing the synechia to mature and then cutting it with scissors a few months later is often all that is necessary. However,

excessive dissection and trauma to the nasal mucosa can lead to more extensive synechiae formation. In these difficult cases, more extensive revision with application of antifibroblastic agents such as mitomycin may be the only solution.[9] Granulation tissue may form at the inner ostium of the DCR site in the early postoperative period, resulting in obstruction of the lacrimal drainage system and epiphora. Using the endoscope, the granulation tissue can be removed from the ostium site with straight microethmoid forceps, relieving the blockage. This complication may occur if direct damage to the mucosal lining of the sac is done at the time of the initial surgery.

Conclusion

Endonasal DCR has increasingly been shown to be as successful as external DCR to treat nasolacrimal duct obstruction.[11] Creation of mucosal flaps at the time of surgery is likely responsible for these excellent results. The mucosal healing without granulation promotes the formation of a predictable mucosal-lined fistula into the nose, similar to an external DCR. Endonasal DCR has numerous advantages over external DCR. It is a minimally invasive procedure, which, with experience, can be performed faster than an external DCR.[15] Therefore, in appropriate patients, the endonasal DCR has become the procedure of choice for nasolacrimal duct obstruction.

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