ENDOSCOPIC DCR

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OTOLARYNGOLOGY ONLINE

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Endoscopic Dacryocystorhinostomy

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Introduction:

Lacrimal system starts with the lacrimal gland which is situated in a pad of fat in the dorsolateral part of the orbital cavity and drains into conjunctival sac via many excretory ducts. The tear film serves as a blanket of moisture over corneal surface thereby preventing dryness of eye. Tears are spread all over the conjunctival lining by the blinking action of upper and lower eyelids. Tears collect in the medial canthal segment of eye where lacrimal lake is situated. Orbicularis oculi muscle acting on the medial canthal ligament including the lacrimal muscle, pump the lacrimal fluid into upper puncta (nearly 30%) and lower puncta (70%) during contraction stage of the muscle. Relaxation of orbicularis oculi and lacrimal muscle directs fluid from puncta and canaliculus to the lacrimal sac as a negative pressure is created in the sac lumen.

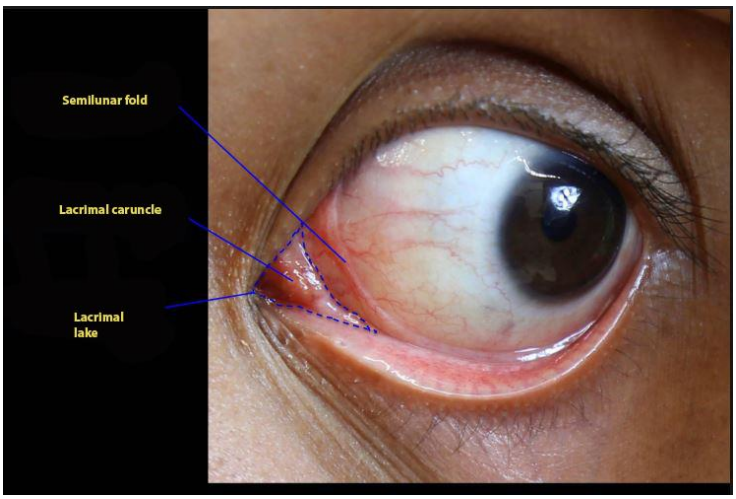


Image showing lacrimal lake

Further contraction of orbicularis oculi muscle and the lacrimal muscle with minimal contribution from gravity compresses the fluid collected in the sac to the nasolacrimal duct situated in the antero lateral wall of the nose, passing anterior to middle turbinate mostly and opening in the anterior portion of the inferior meatus of the nose.

Tarsal plates and tarsal fibers keep the puncta opening directed towards conjunctival lining in the lacrimal lake area. Epiphora can also occur whenever the eyelid is in abnormal position. Blockage of nasolacrimal duct whether due to intra luminal, extra luminal causes decreased outflow of lacrimal fluid and resultant stasis of secretions causes inflammation of naso lacrimal duct as well as lower sac area. Recurrent blockage of nasolacrimal duct ultimately leads to complete adhesions and permanent blockage resulting in dacryocystitis.

History

Surgical treatment of dacryocystitis dates back nearly 2000 years. Celsus, in the first century described a way of creating an artificial passageway into the nose by using hot cautery to puncture through the lacrimal bone. A procedure more or less similar to this was performed by Galen in the second century.

Better understanding of lacrimal anatomy and physiology led to the development of more modern techniques starting from the 18th century. Some of the procedures like dacryocystectomy is no longer advocated. It is of course still being used in patients who are really sick and debilitated, in patients who are on anticoagulants which cannot be stopped.

Several avenues were tried during the early 20th century to manage patients with dacryocystitis. One such procedure was an attempt to drain the lacrimal sac into the maxillary sinus. Many intranasal approaches were described during this period, some of them advocating opening up or resection of the lower aspect of the nasolacrimal canal as well as use of glass tubes or wire to keep the new passageway patent. It was West and Polyak who popularized these procedures with reasonable success.

Earliest operation resembling the modern external DCR was attempted by Woolhouse in England during the 18th century. He advocated extirpation the sac, by perforating the lacrimal bone and placing a drain made of gold, lead / silver. During early 20th century other surgeons attempted to open the sac without removing most of it. Various stenting materials were used to maintain the patency of the ostium.

The first dacryocystorhinostomy was performed by Toti in 1940. This surgery was basically intended for relief of lacrimal obstruction. Toti initially performed this through an external incision. He accessed the sac via an external incision and elevating the periosteum over the sac area. The lacrimal bone is nibbled out exposing the sac. The medial wall of the sac was excised using a canalicular probe as a guide. A corresponding piece of nasal mucosa is also removed. He advocated suturing of the edges of the incised mucosa everting them creating a permanent

drainage of tears into the nasal cavity. The only difficulty encountered in this procedure was significant bleeding from angular vessels. Mosher was the first person to embark on intranasal approach to the sac in 1921, but he too avoided it in favor of combined external and intranasal approach. The advent of nasal endoscopes has revived interest again in the intranasal approach. In addition to avoiding scar formation endoscopes provide excellent visualization. How we have reached a stage where all DCR's are being performed with nasal endoscope by the ENT surgeon.

It should be stressed that 90% of lacrimal pathways belong to the nasal cavity and it is more appropriate for an ENT surgeon to be involved in the management of dacryocystitis.

Embryology:

A clear understanding of embryology of lacrimal system is necessary to understand congenital abnormalities of the nasolacrimal drainage system. The walls of orbit are embryologically derived from neural crest cells. Ossification of orbital walls is completed by birth except for its apex. The lesser wing of sphenoid is initially cartilaginous, unlike the greater wing and other orbital bones that develop via intramembranous ossification. The membranous bones surrounding the lacrimal excretory system are well developed at 4 months of intrauterine life and ossify at birth.

The lacrimal gland begins development at the 25 mm embryologic stage from solid epithelial buds arising from the ectoderm of the superolateral conjunctival fornix. Mesenchymal condensation around these buds forms the secretory lacrimal gland. The early epithelial buds form the orbital lobe in the first two months, whereas the secondary buds which appear rather late at 40 - 60 mm stage, develop into the palpebral lobe. Canalization of the epithelial buds to form ducts occur at 60 mm stage.

The developing tendon of the levator palpebrae superioris muscle divides the gland into two lobes around the 10th week of development. The lacrimal gland continues to develop until 3-4 years after birth.

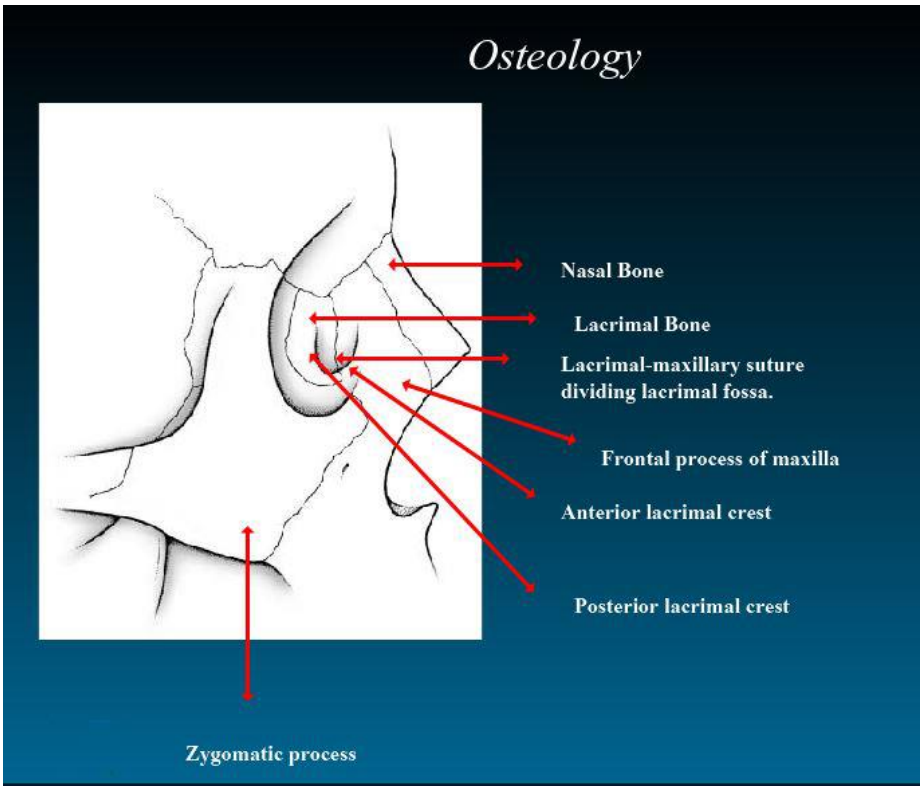
The excretory system begins its development at an earlier stage. In the 7 mm embryo, a depression termed the naso-optic fissure develops, bordered superiorly by the lateral nasal process and inferiorly by the maxillary process. The naso optic fissure or groove gradually shallows as the structures bordering it grow and coalesce. Before it is completely obliterated however, a solid strand of surface epithelium becomes buried to form a rod connected to the surface epithelium at only the orbital and nasal ends. The separation from the surface typically occurs at 43 days of embryonic life. The superior end of the rod enlarges to form the lacrimal sac, and gives off two columns of cells that grow into the eyelid margins to become the canaliculi.

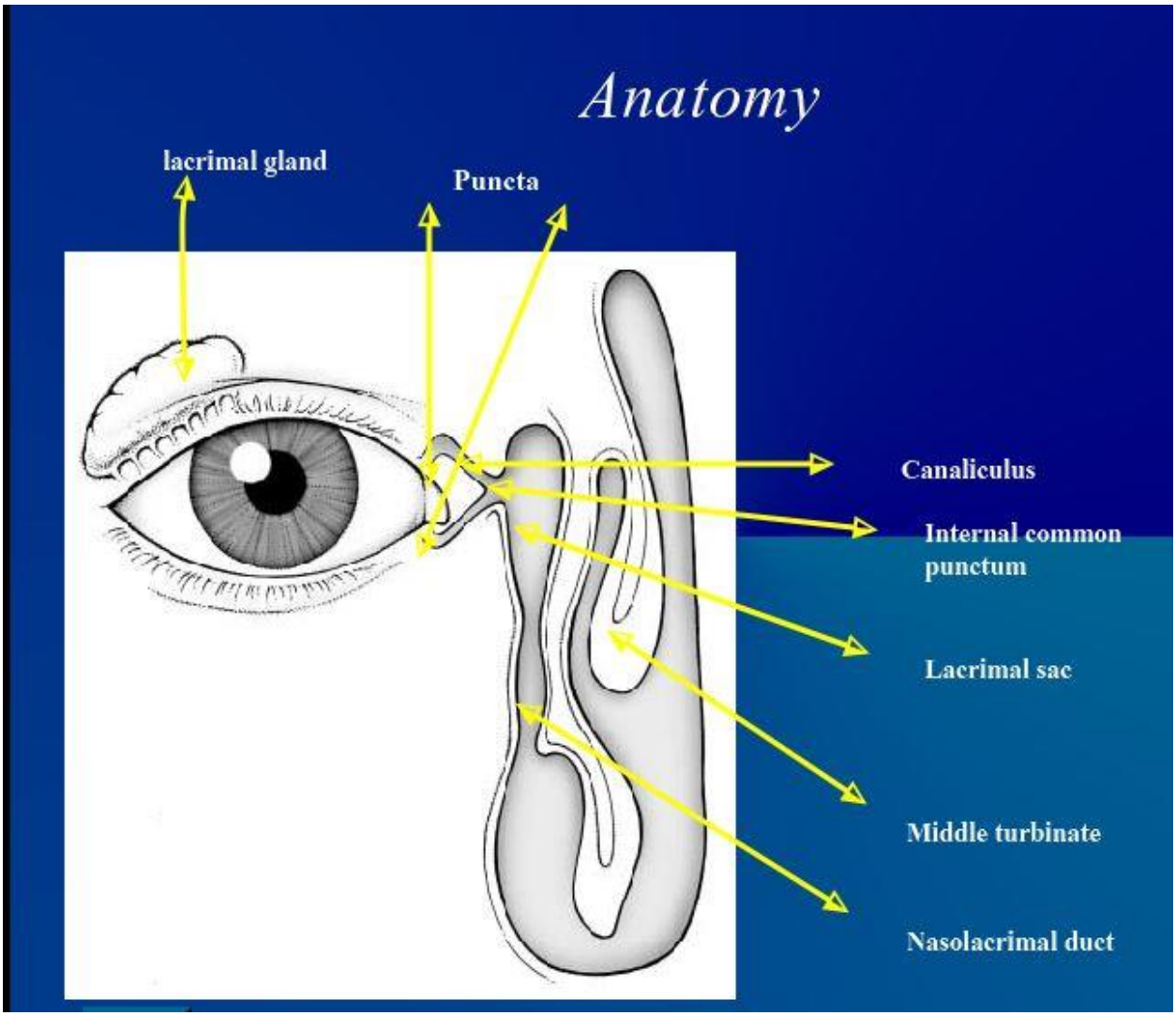
Canalization of the nasolacrimal ectodermal rod begins at about the 4th month proceeding first in the lacrimal sac, the canaliculi, and lastly the nasolacrimal duct. The central cells of the rod degenerate by necrobiosis, forming a lumen closed at the superior end by conjunctival and canalicular epithelium and closed at its inferior end by the nasal and nasolacrimal epithelium. The superior membrane at the puncta is usually completely canalized when the eyelids separate at 7 months of gestation, and therefore is normally present by birth. In contrast the inferior membrane frequently persists in newborns, resulting in congenial nasolacrimal obstruction. Abnormalities of development in this region, occurring typically after the 4th month of gestation can result in congenital absence of any segment of the nasolacrimal system, supernumerary puncta, and lacrimal fistula.

Anatomy:

Osteology:

Thick bone from the frontal process of maxilla forms the anterior lacrimal crest which marks the front end of the fossa. In contrast, thin lacrimal bone forms the posterior lacrimal crest, which marks the rear boundary of the fossa. These two bones fuse at a suture line that traverses the lacrimal fossa in a vertical direction. The inferior end of the lacrimal sac tapers as it enters the nasolacrimal canal formed by the maxillary, lacrimal, and inferior turbinate bones. The nasolacrimal duct runs within the osseous canal for a distance of approximately 12 mm. It continues beneath the inferior turbinate as a membranous duct for an additional 5 mm before opening into the inferior meatus. The duct orifice is found at the junction of middle and anterior thirds of the meatus, approximately 8 mm behind the anterior tip of the inferior turbinate. It is covered by a flap of mucosa known as the Hasner's valve, which is thought to prevent reflux of nasal secretions.

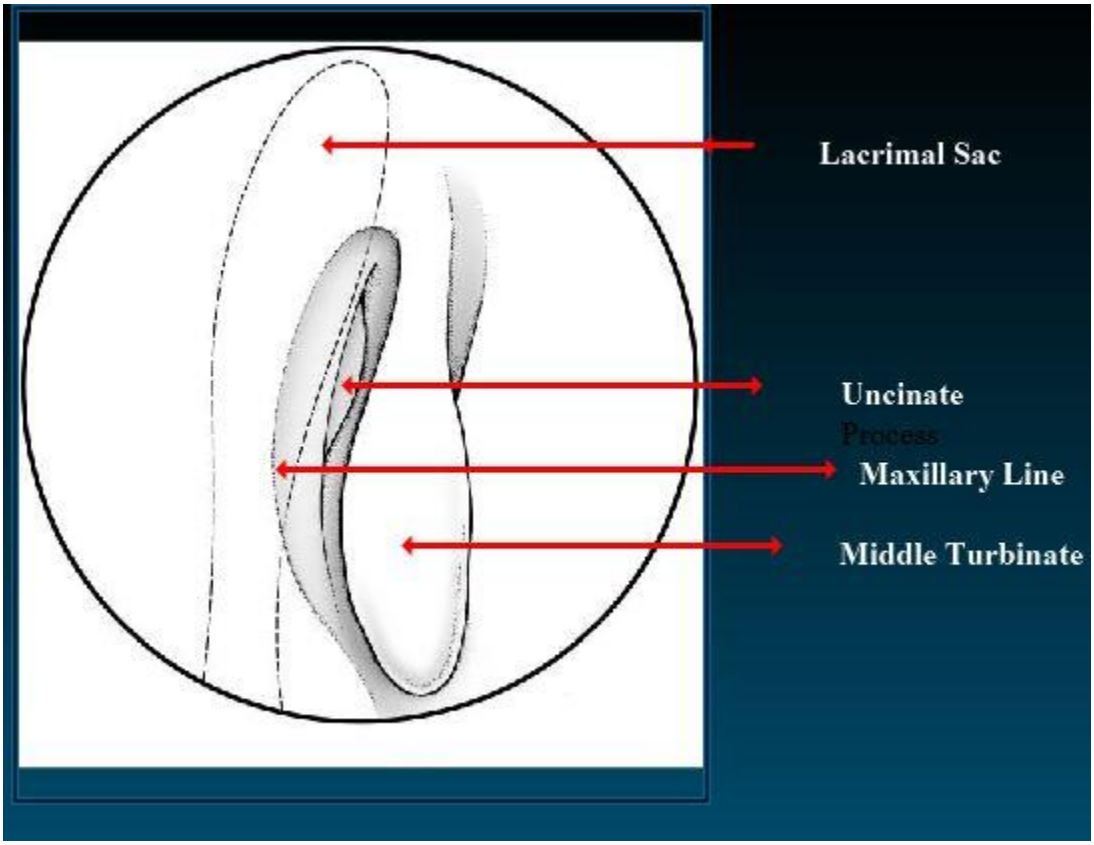


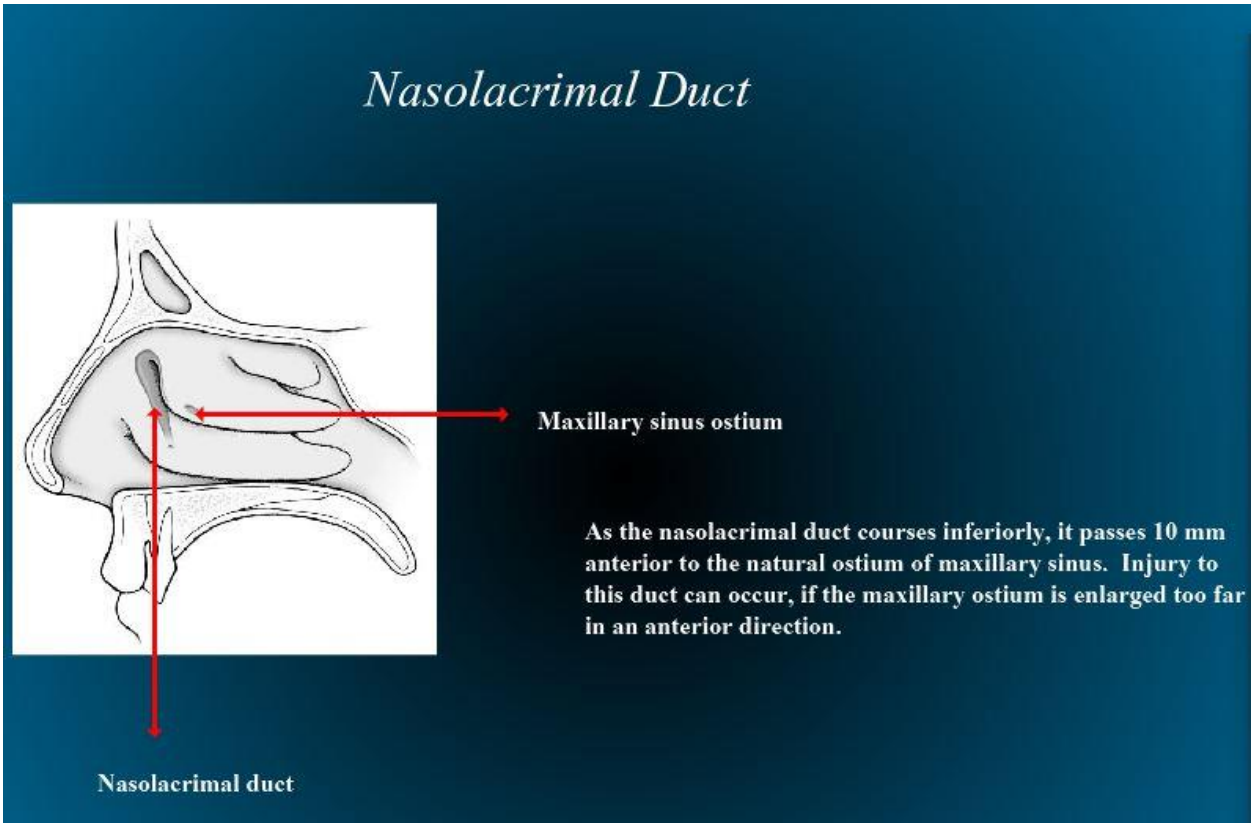


When viewed from within the nasal cavity, the lacrimal sac is located beneath the bone of the lateral nasal wall just in front of the anterior attachment of the middle turbinate. In some patients, the agger nasi cells of the anterior ethmoidal cells overlie the sac, producing an obvious bulge in the lateral nasal wall in this location. The superior border of the sac may extend above the level of turbinate attachment. The posterior end of the sac often extends beneath the middle turbinate, behind a landmark known as maxillary line.

The maxillary line is an important landmark for endoscopic DCR. It is easily identified as a curvilinear eminence along the lateral nasal wall, which runs from the anterior attachment of the middle turbinate to the root of the inferior turbinate. Its location corresponds to the suture line between maxillary and lacrimal bones. Exposure of the posterior half of the sac typically requires removal of thin uncinate process and underlying lacrimal bone located posterior to the

maxillary line. Exposure of anterior sac necessitates removal of thicker bone in front of the maxillary line.





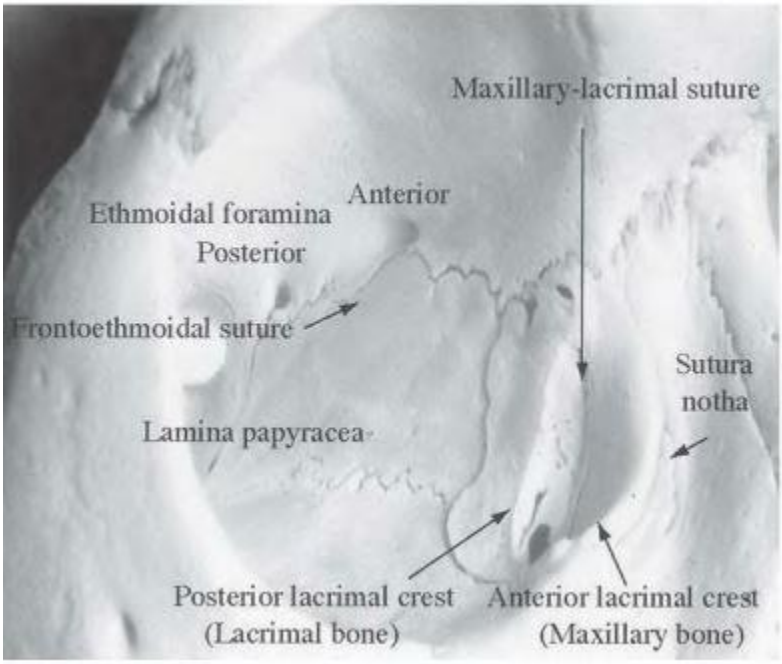
Whitnall described orbital rim as a spiral with its two ends overlapping medially on either side of the lacrimal sac fossa. The medial orbital rim is formed anteriorly by the frontal process of the maxilla rising to meet the maxillary process of the frontal bone. The lacrimal sac fossa is a depression in the inferomedial orbital rim, formed by the maxillary and lacrimal bones. It is bounded anteriorly by the anterior lacrimal crest of maxillary bone and the posterior lacrimal crest of the lacrimal bone posteriorly.

The lacrimal fossa is approximately 16 mm high, 4-9 mm wide, and 2 mm deep. This fossa is slightly narrower in women. The fossa is widest at its base, where it is confluent with the opening of the nasolacrimal canal. On the frontal process of the maxilla just anterior to the lacrimal fossa, a fine groove sutura longitudinalis imperfecta of weber (sutura notha). This suture runs parallel to the anterior lacrimal crest.

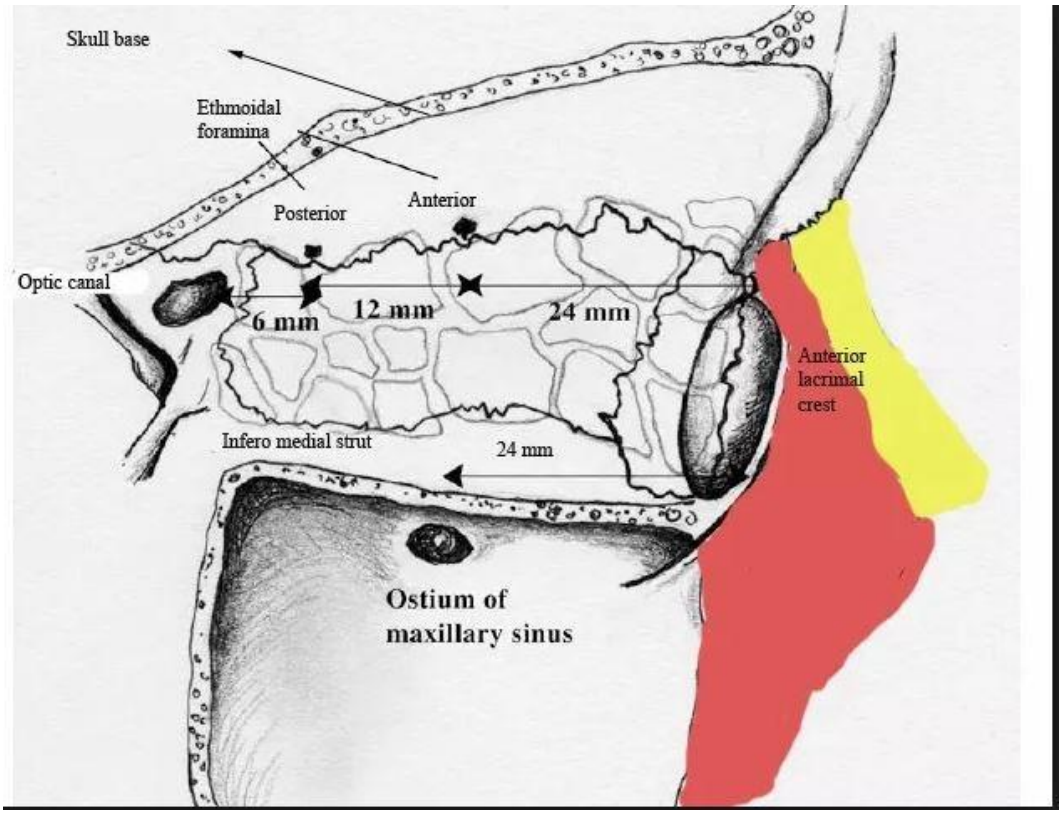
It is a vascular groove through which small twigs of the infraorbital artery pass through to supply the bone and nasal mucosa, and should always be anticipated during lacrimal surgery to avoid bleeding.

The medial orbital wall is formed anterior to posterior, by the frontal process of maxilla, the lacrimal bone, the ethmoid bone, and the lesser wing of the sphenoid bone. The thinnest portion of the medial wall of orbit is the lamina papyracea, which covers the ethmoid sinuses laterally. The many bullae of ethmoid pneumatization appear as a honey comb pattern medial to the ethmoid bone. The medial wall of orbit becomes thicker posteriorly at the body of the sphenoid and again anteriorly at the posterior lacrimal crest of the lacrimal bone.

The fronto ethmoidal suture is very important landmark in orbital anatomy as it indicates the level of roof of ethmoid sinus. Bony dissection superior to this suture line would expose the dura. The anterior and posterior ethmoidal foramina conveying branches of ophthalmic artery and the nasociliary nerve are located in the frontoethmoidal suture, 24 mm and 36 mm posterior to the anterior lacrimal crest respectively.



The anterior lacrimal crest is an important landmark during external dacryocystorhinostomy, as the anterior limb of the medial canthal tendon attaches to the anterior lacrimal crest superiorly. This attachment of the medial canthal tendon is often detached from the underlying bone along with the periosteum in order to gain better exposure during surgery.



Note the ostium of the maxillary sinus lie approximately in a vertical line to the Anterior ethmoidal foramen.

A vertical suture runs centrally between the anterior and posterior lacrimal crests, representing the anastomosis of the maxillary bone to the lacrimal bone. A suture located more posteriorly within the lacrimal fossa would indicate predominance of maxillary bone, whereas a more anteriorly placed suture would indicate predominance of the lacrimal bone.

The lacrimal bone at the lacrimal fossa has a mean thickness of 106 microns, which allows it to be easily penetrated to enter the nasal cavity during surgery. In a patient with maxillary bone dominant lacrimal fossa, the thicker bone makes it more difficult to create the osteotomy in external DCR.

At the junction of the medial and inferior orbital rims, at the base of the anterior lacrimal crest, a small lacrimal tubercle may be palpated externally to guide the surgeon to the lacrimal sac located posterior and superior to it. In nearly a third of orbits this tubercle may project posteriorly as an anterior lacrimal spur.

The nasolacrimal canal originates at the base of the lacrimal sac and is formed by the maxillary bone laterally and the lacrimal and inferior turbinate bones medially. The width of the superior portion of the canal measures on an average 4-6 mm. The duct courses posteriorly and laterally in the bone shared by the medial wall of the maxillary sinus and the lateral nasal wall for 12 mm to drain into the inferior meatus of the nasal cavity.

Epiphora:

This term is used to indicate excessive tear secretion. Causes for epiphora include:

1. Hypersecretion
2. Epiphora
3. Combinations of the above

Hypersecretion:

Excessive tearing is caused by reflex hypersecretion due to irritation of cornea / conjunctiva (FB, trigeminal nerve stimulation).

Epiphora:

Usually occurs due to poor lacrimal drainage which could be due to:

1. Mechanical obstruction of lacrimal drainage system related to trauma, dacryocystolithiasis, sinusitis and congenital nasolacrimal duct obstruction in children
2. Lacrimal pump failure (functional epiphora) may be caused by eyelid laxity (facial palsy), eyelid malposition and punctum eversion

Assessment:

Patients with obstruction of the lacrimal system commonly present with epiphora. When dacryocystitis is present, purulent discharge in the medial canthal region can occur.

History of nasal airway obstruction, drainage, or epistaxis must be sought to rule out nasal causes of epistaxis.

Clinical History & Examination:

Detailed history should be taken to rule out / differentiate:

1. Differentiate between hypersecretion, lacrimation and epiphora
2. Define the pathological process
3. Distinguish whether tearing is due to a functional or anatomical disorder
4. Identify the site of blockage
5. If required a surgical approach may be defined

Physical examination:

Should include:

Eyelids: lower lid laxity, ectropion, entropion, punctum eversion, trichiasis, and blepharitis

Medial canthus: Lacrimal sac enlargement below the medial canthal tendon

Palpation of lacrimal sac: Reflex of mucopurulent material from the punctum; pressure over the sac in acute dacryocystitis would cause pain.

Image showing tear efflux on applying pressure over medial canthus of the eye

Preoperative ophthalmologic examination begins with inspection of the ocular surface and eyelid structures. Gentle pressure over the lacrimal sac may produce reflux of mucopurulent material suggestive of lower sac obstruction. The puncta are evaluated for scarring or strictures. The canaliculi are gently probed using Bowman lacrimal probe after anaesthetizing the eye using proparacaine. Any resistance encountered when passing the probe is noted. Presaccal stenosis is excluded because this condition is not suitable for endoscopic DCR. Results of visual acuity, extraocular motility, and visual field defects are also noted.

Special investigations:

Diagnostic tests can be used to identify the cause of obstruction and to choose the appropriate treatment modality. These tests can be classified as:

1. Anatomical tests used to locate the site of obstruction:
    a. Diagnostic probing
    b. Syringing
    c. Dacryocystography
    d. Nasal examination
    e. Imaging
2. Physiological / Functional tests
    a. Fluorescein dye appearance
    b. Scintigraphy
    c. Saccharine test

3. Secretion tests
    a. Schirmer's test
    b. Bengal rose test
    c. Tear film breakup test
    d. Tear lysozyme test

Diagnostic probing & lacrimal syringing:

Diagnostic probing and irrigation of lacrimal system are very important anatomical tests. They provide valuable information about the site of obstruction, but usually don't give information about functional efficiency. These are really useful skills an otolaryngologist needs to learn from the ophthalmologist.

Syringing:

This procedure can easily and safely be performed in the OPD under local anesthesia.

Steps:

Topical anesthesia is secured by application of 1 – 2 drops of oxybuprocaine / Benoxinate HCL 0.4% or 4% xylocaine onto the puncta.

The puncta is dilated next using a punctum dilator if the punctum is small.

Image showing lower punctum being dilated

Image showing a punctum dilator

A 24-gauge intravenous cannula is inserted into the inferior canaliculus, it should be aimed vertically first and then turned horizontally. The lower canaliculus is straightened by pulling the lower eyelid downwards and laterally.

The tip of the cannula is advanced to 3-4 mm into the canaliculus. A 2 ml syringe filled with distilled water is attached to the canula and is irrigated by pushing the plunger of the syringe. Initially a small (00) probe should be used, followed by progressively larger probes if possible. If a hard stop is felt during probing the canaliculi it means that the probe has come into contact with the lacrimal bone suggesting that the lacrimal drainage is patent up to the lacrimal sac. Rarely a soft stop may be felt indicating that the probe's progress is impeded by soft tissue suggesting the presence of stenosis or obstruction of the canalicular system. Soft stop can also be cause by kinking of the canaliculus created by bunching of the soft tissues in front of the probe tip. Such kinking can be eliminated by withdrawing the probe, increasing lateral traction on the lid and probing again.

Once the probe reaches the lacrimal sac as indicated by the hard stop, it is rotated superiorly with the body of the probe against the brow. Once the probe is rotated to the level of supraorbital notch at the superior orbital rim, it is guided down the nasolacrimal duct, directed slightly posteriorly and laterally as it is advanced. Resistance at this level should not be overcome by force, instead the probe should be withdrawn and reintroduced. Once the probe is believed to have passed to the level of the inferior meatus, its position can be confirmed by using a nasal endoscope into the inferior meatus.

If irrigation is successful and no reflux exists, but the lacrimal sac becomes distended with no saline passage into the nose, then it demonstrates nasolacrimal duct obstruction with a competent valve of Rosenmuller that prevents reflux back into the canalicular system. In some patients, some degree of reflux through the opposite canalicular system could be observed, but the patient would still feel the taste of saline trickling down the throat. This indicates that the patient may have partial nasolacrimal duct obstruction. Despite the passage of fluid under the positive pressure of the irrigation cannula, partial nasolacrimal duct obstruction can create enough resistance to inhibit tear drainage under physiologic pressures.

Probing and irrigation will help in the assessment of anatomical and functional status of the lacrimal drainage system. If performed correctly it is a safe procedure providing extremely useful diagnostic information, as well as assistance in the surgical planning when pathology is encountered. In cases of trauma, this procedure can help to assess the integrity of the system and look for the presence of canalicular injury. It is very useful in cases of epiphora, which could be caused due to over production of tears or due to inadequacy of the drainage system. This procedure an be used as a treatment for congenital nasolacrimal duct obstruction.

Lacrimal drainage system:

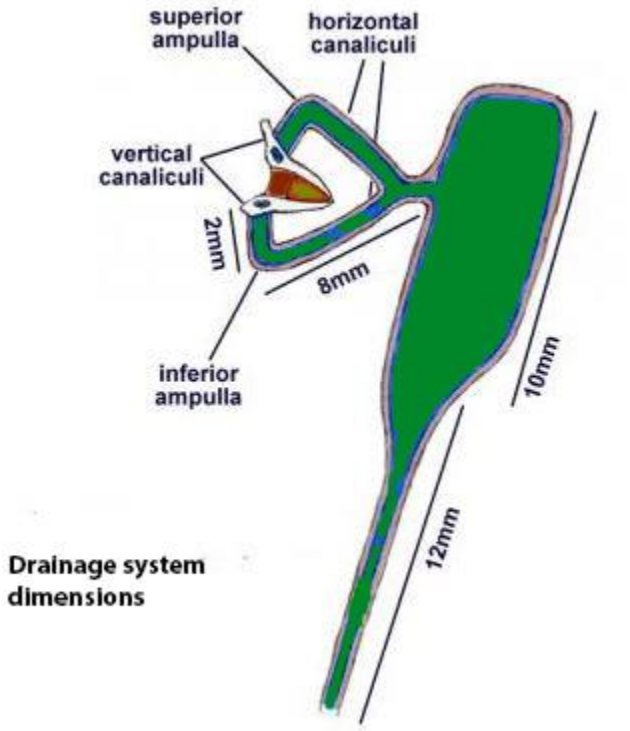


Diagram illustrating lacrimal drainage system

Lacrimal drainage system begins at the puncta, which are located medially on the margins of the upper and lower eyelids. Each punctum leads to its own canaliculus. These canaliculi (upper and lower) pass approximately 2 mm vertically, then turn 90^0 and run 8-10 mm medially to join the lacrimal sac. In majority of patients these canaliculi join to form a common canaliculus that enters the lacrimal sac. Some patients at this point may have a fold of tissue that is considered to create a functional one-way valve preventing reflux into the canaliculi. This value is known as the valve of Rosenmuller.

The lacrimal sac lies in a bony fossa in the anterior medial orbit and extends inferiorly to form the nasolacrimal duct. This duct measures 12 mm in length and has a distal valve of Hasner, before it opens into the nose thorough an ostium at the inferior meatus. This ostium is patent in approximately 50% of infants at birth. If it is not patent at birth, it usually becomes patent during the first few months of life. Delayed or incomplete patency is the cause of congenital nasolacrimal duct obstruction. In infants the distance from the punctum to the level of inferior meatus is approximately 20 mm.

Indications for probing & irrigation:

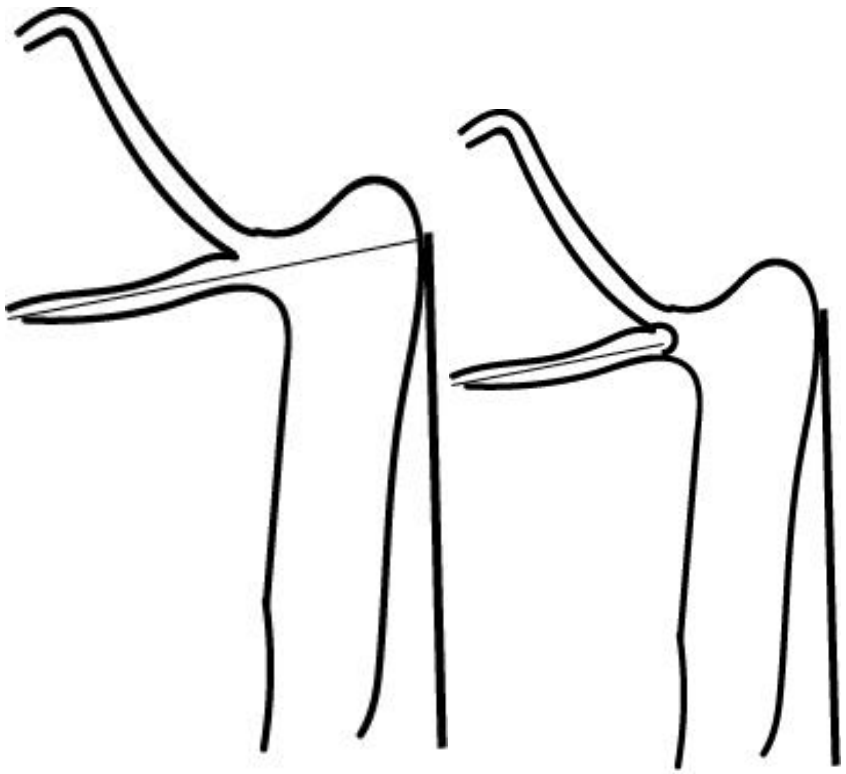
1. Should be performed whenever analysis of the lacrimal drainage system is indicated
2. In the case of nasolacrimal obstruction related epiphora, this procedure provides insight into the location and severity of obstruction if present. It helps to identify the cause of epiphora and also assist in surgical planning
3. In case of trauma to eyelid or medial face, probing and irrigation will help to determine if there is injury to the lacrimal drainage system. In patients with acute trauma, a visible lacrimal probe inserted into the canaliculus or leakage of irrigation fluid through traumatized eyelid is an indication for canalicular injury and must be addressed during planned repair of trauma.
4. In patients with congenital nasolacrimal duct obstruction that does not resolve by the age of 12 months, probing and irrigation is performed under anesthesia to achieve patency of the system.

Contraindications for probing & irrigation:

1. Obstruction due to acute dacryocystitis. In these patient's palpation of a distended lacrimal sac produces reflux of mucopurulent material from the canalicular system. Presence of this reflux confirms complete nasolacrimal duct obstruction and no further diagnostic testing is indicated.
2. Presence of acute canaliculitis. Active infection can make passage of probe difficult. Another concern being the presence of stones within the canaliculus. Probing can force these stones to migrate deeper into the canaliculus making its subsequent removal difficult.

Complications:

1. Injury to canaliculi
2. Injury to nasolacrimal duct
3. Creation of false passage
4. Stenosis



Hard Stop

Soft Stop

Jones Dye Tests:

Jones dye tests can help in assessing the patency of the lacrimal drainage system. The Jones I test is a functional measure of tear drainage that involves the placement of a drop of fluorescein dye in to the eye. A cotton tipped applicator is placed into the inferior meatus adjacent to the nasolacrimal ostium at 2 and 5 minutes. If dye is recovered, patent anatomy and physiologic functions can be confirmed. This test is prone for high false negative rate which can range up to 42%. Rigid endoscope can be used to directly visualize the dye in the inferior meatus. When Jones I test is abnormal, then Jones II test may be used to evaluate anatomic patency in the presence of increased hydrostatic pressure of tear flow. A canaliculus is irrigated with clear saline using a syringe with blunt tipped needle. If saline passes into the nose or mouth a partial nasolacrimal duct obstruction is likely since this obstruction could be overcome by the pressure of irrigation but not passive flow.

If fluorescein stained saline does not flow freely into the nose, but regurgitates from the other punctum, a high-grade anatomic obstruction is likely at the level of the lower sac or duct. Such an obstruction may be amenable to surgical correction by DCR.

If the Jones II test results in regurgitation of clear saline from a punctum, canalicular or common canalicular obstruction is suggested. Conjunctivodacryocystorhinostomy (CDSR) with Jones tube placement may be useful in such patients to bye pass the proximal blockage.

Radiological investigations are done if doubt exists about the surgery that is required. Both Dacryocystography and scintigraphy provide some idea of the level of obstruction and whether a tight common canaliculus is contributing to the epiphora.

Dacryocystography:

This is indicated when there is obstruction in the lacrimal system with syringing. It can assist with understanding the internal anatomy of lacrimal system.

Indications include:

1. Complete obstruction - size of the sac, determining the exact site of obstruction (common canaliculus or sac)

2. Incomplete obstruction and intermittent tearing - site of stenosis, diverticula, stones, and absence of anatomical pathology

3. Failed lacrimal surgery - size of the sac

4. Suspicion of sac tumors

Nuclear lacrimal scintigraphy:

This is a functional test, and is useful to assess the site of delayed tear transit. It is especially helpful in difficult cases with an incompletely obstructed system (questionable eyelid laxity and questionable epiphora).

CT:

Is used with tumors, rhinosinusitis, facial trauma, and following facial surgery. In the presence of concomitant sinus disease, CT assists a surgeon to address the sinuses at the same time as the DCR.

MRI is rarely used to investigate patients with epiphora.

Role of nasal endoscopy in evaluation of patients:

The inferior meatus is examined using a nasal endoscope for any masses that could obstruct the drainage of nasolacrimal duct. The middle meatus is examined for evidence of sinusitis or polyps. A septal deviation or enlarged middle turbinate if any are noted, because these could hamper the surgery. For these examinations it is better to use 2.7 mm nasal endoscope. The main aim in performing a detailed endoscopic examination before surgery is to avoid any surprises on the table at the time of surgery.

Radiologic evaluation:

CAT scan of the sinuses must be performed before performing endoscopic DCR for identifying preexisting sinus disease or other anatomical abnormalities not recognized on physical examination. Both coronal and axial scans are preferred. MRI scans are not obtained because they do not image the bony partitions of the sac and sinuses.

Dacryocystogram:

It is essential to identify and document the location and degree of lacrimal obstruction. Radiopaque contrast media is injected into the canaliculi while an x-ray is taken. Dye should flow through the duct and drain into the nasopharynx if no obstruction is present. When an obstruction is present, a dilated lacrimal sac is often observed proximal to the obstruction. The most common site of obstruction is at the sac-duct junction. Filling defects representing lacrimal stones may also be seen.

Surgical indications:

1. Persistent epiphora due to chronic dacryocystitis

2. Nasolacrimal duct obstruction

3. Secondary causes of lacrimal obstruction like trauma, infection, neoplasm and lacrimal stones.

4. If canaliculi are obstructed, a CDCR is necessary in order to byepass the blockage and drain tear fluid directly into the nasal cavity through a Jones tube.

Contraindications:

1. Endonasal DCR should not be done when malignant tumor is in proximity of Nasolacrimal duct as it could very well be the cause of obstruction
2. Benign growths, sinonasal polyposis, septal deviations, allergic rhinitis, atrophic rhinitis as such are not absolute contraindications, but since these pathologies themselves could cause obstruction they should be diligently eliminated as causative factors
3. If the patient is suffering from acute dacryocystitis it is advisable to cool down the acute phase by I&D followed by a course of antibiotics. After the acute infection is cured the patient may be taken in for endoscopic DCR.
4. Failed previous (external) are fit candidates for EEDCR provided the sac has not been excised in toto

Procedure:

Endoscopic DCR is ideally performed under local anesthesia / general anesthesia with endotracheal tube anesthesia.

Position:

The patient is placed in supine position, either flat or slightly flexed head to 15 degrees and slightly rotated towards the surgeon. Ideally a dental syringe is used for infiltration. 2 ml of 1% xylocaine with 1:100,000 adrenaline is infiltrated into the axilla of the middle turbinate and the frontal process of the maxilla.

Image showing the points of infiltration

Instruments needed:

1. Dental syringe
2. No 15-scalpel blade
3. Suction Freer elevator
4. Kerrison punch
5. 2.75 mm Cataract knife
6. Small Blakesley forceps
7. Punctum dilator and probes
8. DCR intubation set
9. 0-degree nasal endoscope
10. HD camera and monitor

4 mm 0-degree nasal endoscope is used to perform the surgery. First the canaliculus is cannulated with a 20-gauge fiberoptic light probe and is passed up to the lacrimal sac. This probe trans illuminates the lateral nasal wall, providing information as to the location of the sac. The area of maximum brightness corresponds with the posterior end of the lacrimal sac where the overlying bone is thinnest, and not the center of the sac.

Dissection is begun with removal of approximately 1 cm diameter circle of mucosa at the area of transillumination along the lateral nasal wall. The underlying bone is also removed with

back-biting forceps. Medial wall of the sac is exposed. It is quicker to remove bone with a Kerrison's punch than with a DCR burr. DCR burr is needed only when the punch is unable to engage the bone adequately. Opening is made in the medial wall of the sac with a sickle knife. Some surgeons even go to the extent of removing considerable portion of the medial wall to ensure adequate drainage of tear secretion.

This procedure can also be performed without using illuminated lacrimal sac probe. The author still prefers to use the technique given below:

Creation of a posteriorly based mucosal flap to expose lacrimal bone:

A 15-scalpel blade is used to make a superior incision that runs horizontally 8-9 mm above the axilla of the middle turbinate. A suction diathermy can be used to cauterize the incision line before making the cut in order to reduce bleeding during the procedure. This incision can be extended anteriorly to about 10 mm onto the frontal process of maxilla.

The blade is turned vertically to make a cut onto the frontal process of the maxilla from the superior incision to just above the insertion of the inferior turbinate.

The blade is turned horizontally and inferior incision is made from the insertion of the uncinate to join the vertical incision.

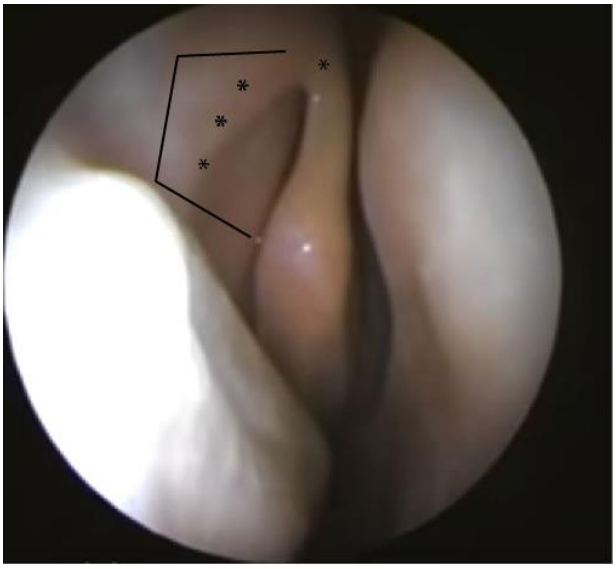


Image showing the incision

Bone removal to expose the sac:

A Kerrison punch is used to remove the bone of frontal process of the maxilla overlying the sac.

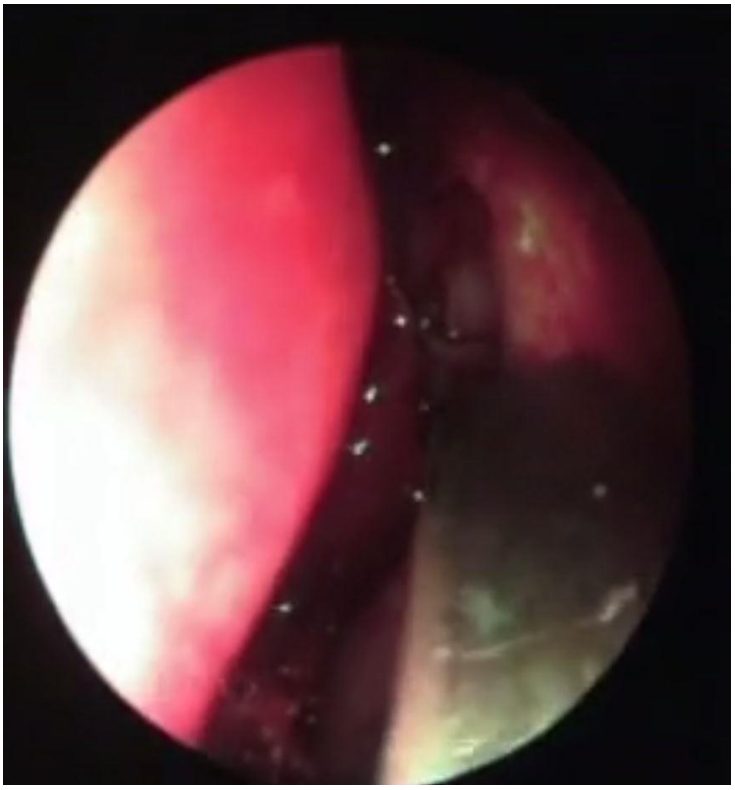


Image showing Kerrison's punch in action

It is quicker to remove bone with a Kerrison's punch. DCR burr is used only when the punch is unable to adequately engage the bone. The sac is exposed by removing bone up to the mucosal incisions so that the sac forms a prominent bulge into the nasal cavity.

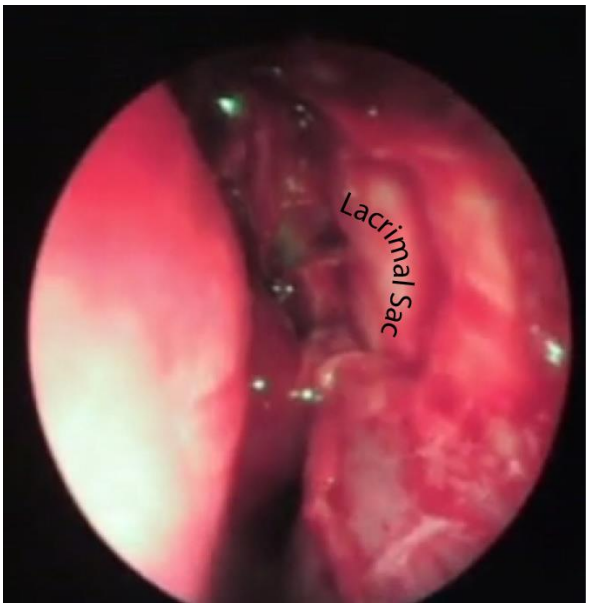


Image showing sac prolapsing into the nasal cavity

All the lacrimal bone is removed up to the uncinate, but uncinate is not disturbed. A lacrimal probe should be passed from the puncta through to the nasal cavity without feeling any bone obstructing the path of the probe. If it is not so, then more bone needs to be removed superiorly.

The retrolacrimal region where the uncinate inserts into the lamina papyracea is extremely thin, so care should be taken not to cause accidentally orbital injury.

The common canaliculus opens high on the lateral wall of the sac and this area should be exposed during endo DCR for a better result.

Exposure of agger nasi cell:

The agger nasi cell is situated medially, superiorly and more posteriorly to the lacrimal fossa. The agger nasi cell is opened using a Kerrison punch. This allows better exposure of the sac and allows mucosa of the sac to lie against the agger nasi mucosa.

Marsupialization of the sac:

The superior / inferior canaliculus should be cannulated taking care not to make a false passage in to the delicate lacrimal system. The lacrimal sac is tented with the lacrimal probe under

endoscopic vision. The medial wall of the sac is incised using a DCR knife or cataract knife to vertically incise the sac. Bellucci micro ear scissors can be used to release the mucosa. The sac must be widely marsupialized and widely open and lying flat on the lateral nasal wall.

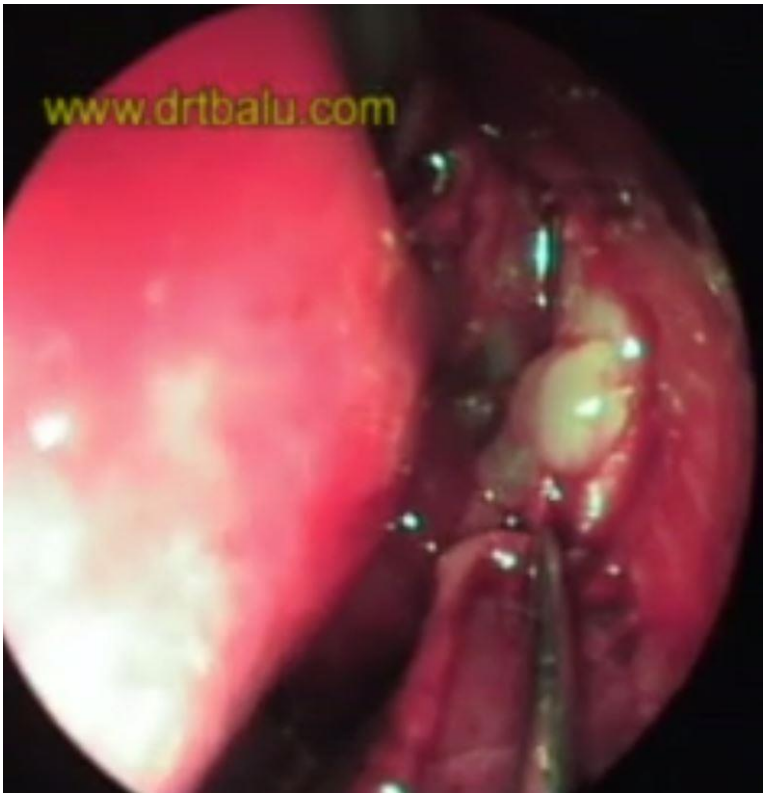


Image showing the lacrimal sac wall incised and discharge streaming out

The mucosal flap is preserved until end of the surgery. The mucosal flap is trimmed in such a way that only small superior and inferior rims remain and the lacrimal sac remains wide open. The reminder of the flap is placed over the lateral wall of the nasal cavity, ensuring that the exposed bone is covered.

Some authors prefer to insert stents to keep the tract patent. Author prefers using gelfoam soaked in methotrexate over the incised sac area to prevent scar tissue formation and closing the sac opening.

Post-operative care:

1. Patients can be generally discharged within a few hours
2. A 5 day course of decongestant nasal drops need to be prescribed
3. Antibiotic eye drops to be applied for 2 weeks
4. Periodical nasal douching

5. Crusts to be removed to remove adhesions
6. Silastic tubes if used should be removed after 6 weeks

Complications:

1. Bleeding - if excessive procedure should be abandoned in favor of external DCR

2. If orbital fat is exposed during the procedure it must be left undisturbed to prevent damage to orbital contents

3. Post op bleeding may be encountered in about 5% of patients

4. Post Op adhesions are also common leading to attendant complications. This can be avoided if turbinate mucosa is left untouched and merocel packing is used to pack the nose post operatively.