

## CHAPTER 9

# SURGERY OF THE LACRIMAL DRAINAGE SYSTEM

The lacrimal drainage system drains the tears from the conjunctival sac into the nose. Obstruction in the lacrimal passages may occur at various sites (fig. 9.1). In all cases there will be watering of the eye called epiphora.

1. *The nasolacrimal duct.* This is the most common site for obstruction. As a consequence the lacrimal sac often enlarges (a mucocoele) and becomes infected (dacryocystitis). This causes chronic conjunctivitis and a muco-purulent discharge from the eye. Dacryocystitis is found particularly in communities where chronic eye and nose infections such as trachoma are common. It appears to be more prevalent amongst Caucasians and people from the Indian sub-continent, probably because of the shape of their nasal bones and their narrower nasal bridge.
  2. *The punctum.*
  3. *The common canaliculus.*
- } Obstruction at either the punctum or the common canaliculus will result in epiphora but there will be no enlargement or infection of the lacrimal sac. Therefore the eye waters but is free from infection.

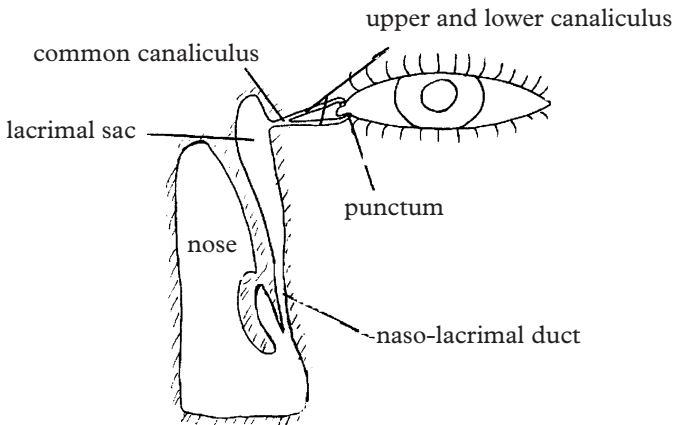


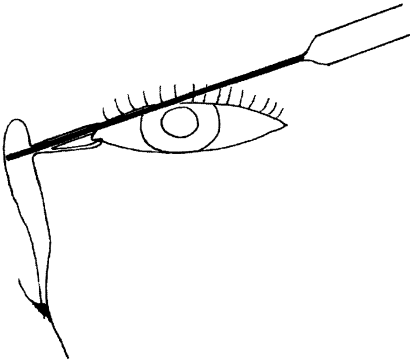
Fig. 9.1 To show the anatomy of the lacrimal drainage system

## Probing of the nasolacrimal duct

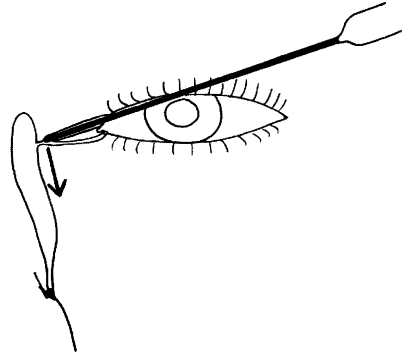
### Indications:

The main indication is for congenital obstruction of the duct in young children. This is usually caused by a thin membrane which obstructs the lower end of the duct. This membrane often ruptures spontaneously as the baby grows. If the symptoms of epiphora and discharge have not improved spontaneously by the age of 18 months to 2 years, then probing of the duct should be carried out under general anaesthetic. The success rate is about 80%.

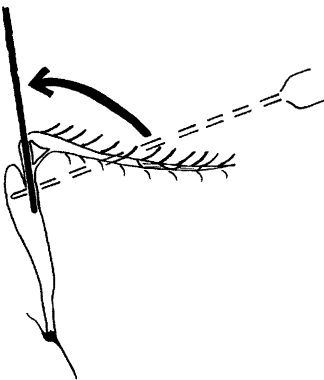
Probing can also be done in adults under local anaesthetic, but in adults it has a much lower success rate.



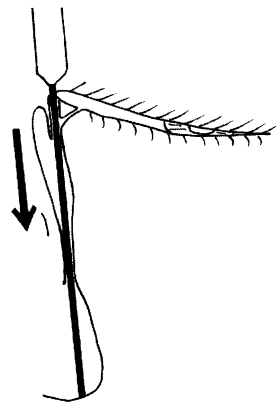
*Fig. 9.2* Probing through the upper punctum. The tip of the probe has entered the lacrimal sac and rests against the hard nasal bone



*Fig. 9.3* Probing through the upper punctum. The tip of the probe has not reached the lacrimal sac. Any attempt to proceed with probing will cause a false passage through the tissues as shown by the arrow



*Fig. 9.4* The probe is rotated across the forehead to point downwards and very slightly outwards and backwards



*Fig. 9.5* The probe is advanced down the naso-lacrimal duct, through the obstruction at its lower end till it hits the hard palate at the floor of the nose

*Method:*

1. Dilate the punctum with a punctum dilator. Then pass a fine probe along the canaliculus to enter the upper part of the lacrimal sac. This can be done through either the upper or the lower punctum. It is better to use the upper punctum but it is easier to use the lower punctum.
2. Make sure that the tip of the probe is definitely in the lacrimal sac. The tip should rest against the lateral side of the nasal bone and the hard bone can be felt against the tip of the probe (a "hard stop") (fig. 9.2). If the tip is not resting against something hard and bony then it has not reached the lacrimal sac (a "soft stop") (fig. 9.3). In this case it is harmful to proceed further as it will only create a false passage through the tissues. This is a very serious complication and can cause permanent damage to the common canaliculus which is the narrowest part of the lacrimal passages. Therefore the child may have a watering eye for the rest of its life. If you do not feel a "hard stop" with the probe you should not proceed any further.
3. Keep the tip of the probe resting against the bone and rotate the probe to point down and very slightly out (laterally) and back (posteriorly) (fig. 9.4). In this direction it can be advanced from the lacrimal sac down into the nasolacrimal duct. There will usually be some resistance at the lower end of the nasolacrimal duct from the congenital membranous obstruction. Then the probe tip will enter the nose and hit the hard bone of the palate (fig. 9.5).
4. Some people like to confirm the success of the probing by then syringing the nasolacrimal passages, but be careful that the fluid does not go into the lungs of an anaesthetised baby.

**Dacryocystectomy**

The infected lacrimal sac is excised. This removes the source of infection and therefore cures the secondary conjunctivitis, relieving most of the symptoms. However the lacrimal passages are destroyed by the operation, so the eye continues to water.

*Indications:*

Dacryocystitis in adults where surgical facilities are not good. It is a fairly simple and easy operation, although there may be quite brisk bleeding from the superficial facial veins under the skin. Dacryocystectomy is particularly suitable for elderly patients who do not produce so many tears.

*Method:*

1. Inject around the lacrimal sac with local anaesthetic and adrenaline. It is helpful to block the infratrochlear and infraorbital nerves as well (fig. 9.6). The infra trochlear nerve carries the sensory nerve fibres from most of the lacrimal sac area. It can be blocked by injecting either through the skin in the upper and inner corner of the orbit, or through the conjunctiva just above the caruncle. Advance the needle about 2 cm. keeping close to the medial wall of the orbit and inject about 2 ml. of local anaesthetic with adrenaline. The infra orbital nerve can be blocked where it emerges just below the infraorbital ridge.

2. An incision is made directly over the lacrimal sac, in the line of the skin crease (fig. 9.6). This incision should be just lateral to the lacrimal crest. This is the bony ridge which can be felt with the finger-tip between the bridge of the nose and the orbit. The incision starts at the level of the medial canthus and passes downwards and outwards for about 2 to 3 cm. The skin on the two sides of the incision is held open either with sutures, a small self-retaining retractor, or by an assistant using two small retractors. The incision is deepened using blunt dissection through the Orbicularis Oculi muscle. There is often considerable bleeding from the angular vein and its branches. The bleeding points should be identified and secured in the usual way with ligature or diathermy.
3. Identify the lacrimal sac. This is usually enlarged and easy to find. If there is difficulty in finding it, then identify the bony lacrimal crest, and the lacrimal sac will be just lateral to the crest and a little deeper under a layer of fascia (fig. 9.7). Grasp the lacrimal sac with artery forceps. Then by gently pulling

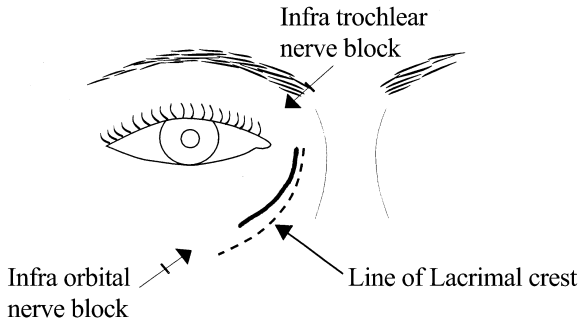


Fig. 9.6 To show the incision for dacryocystectomy and the site of the nerve blocks

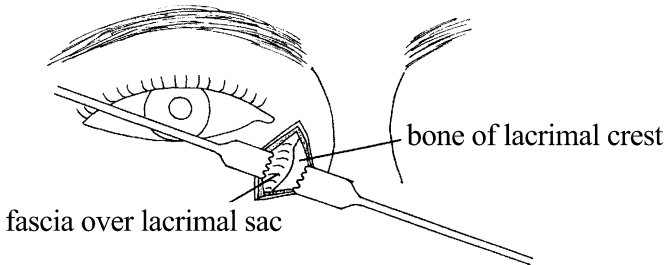


Fig. 9.7 The skin and orbicularis muscle have been retracted to show the bony lacrimal crest and the fascia lying over the lacrimal sac

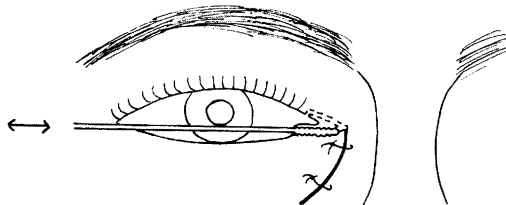


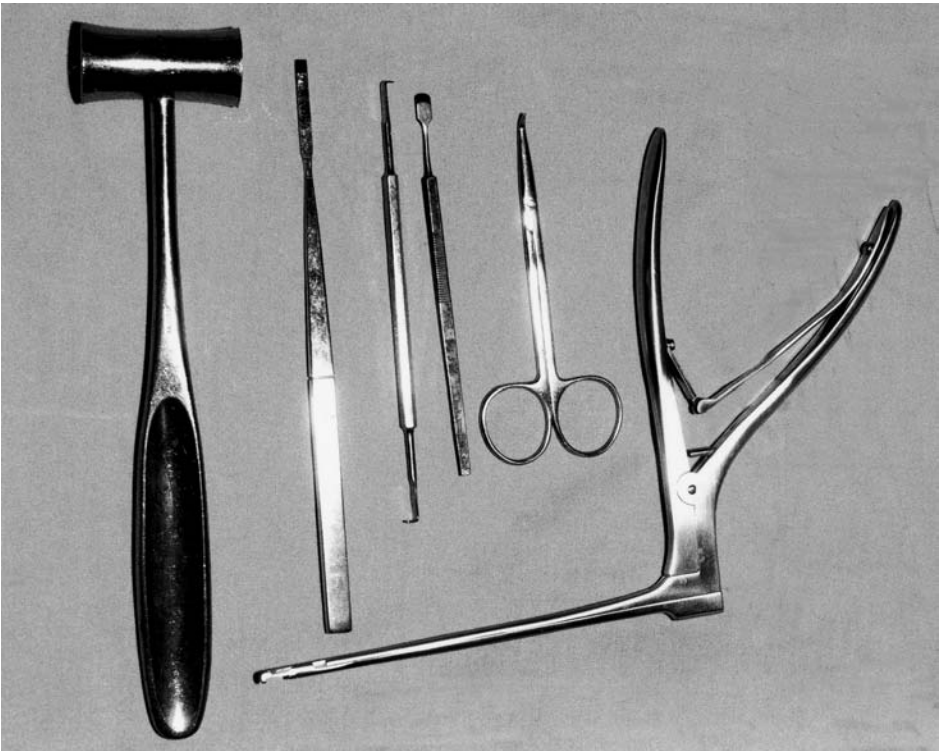
Fig. 9.8 Using the canaliculus rasp

and twisting on the artery forceps while dissecting carefully around the sac, remove the entire mucous wall of the sac and as much of the nasolacrimal duct as is easily accessible. The lacrimal sac may rupture or leak mucopurulent material and it may be necessary to remove the mucous wall of the sac in several pieces rather than in one piece. If there is doubt about whether some pieces of the lacrimal sac mucosa are still present, these can be destroyed with chemical cautery. A swab stick moistened in phenol can be applied to the tissues, and after a short pause the phenol residue is then irrigated away.

4. Close the skin incision with one or two interrupted sutures.
5. Use a canaliculus rasp if it is available to scrape the mucous membrane from the canaliculi. This is an optional extra and not essential (fig. 9.8).
6. Although the lacrimal passages are destroyed the operation will greatly reduce the symptoms by removing the source of infection from the conjunctiva and lacrimal sac.

### **Dacryocystorhinostomy**

This is an operation in which the lacrimal sac is anastomosed to the nasal mucous membrane. It is a better operation for dacryocystitis than a dacryocystectomy



*Fig. 9.9a* The instruments required for a dacryocystorhinostomy. A hammer, a chisel, Traquair's periosteal elevator, a straight periosteal elevator, right angled scissors and a bone punch.

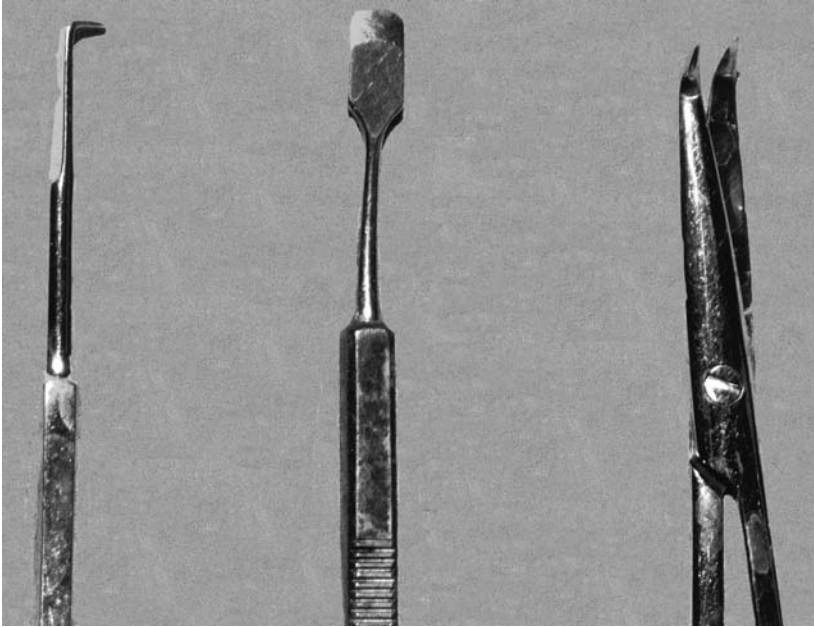


Fig. 9.9b An enlarged view of the smaller instruments

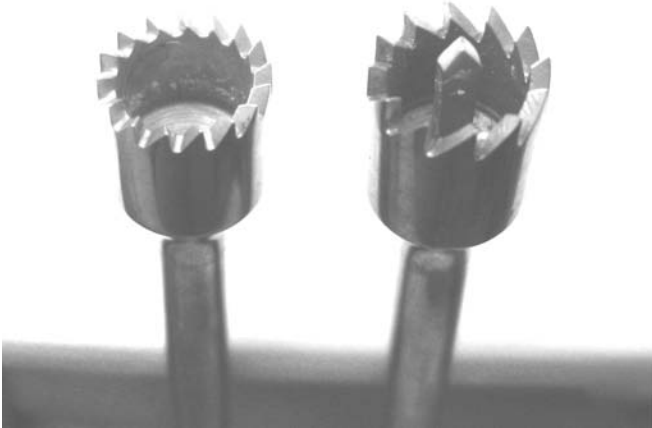


Fig. 9.9c A picture to show the tips of the lacrimal bone trephines

because the patient is not left with a watering eye. The success rate should be about 90% and it successfully cures all the symptoms. However the operation is much more difficult and takes much longer than a dacryocystectomy. Special instruments are required (fig. 9.9a-c) and there is often considerable bleeding. A dacryocystorhinostomy (DCR) can be done under local anaesthetic if the patient is cooperative, but a general anaesthetic is more acceptable.

The aim of the operation is to excise the bone between the lacrimal sac and the middle meatus of the nose, and then suture the lacrimal sac mucosa to the nasal mucosa of the middle meatus. Figures 9.10 and 9.11 show in outline what the operation is trying to achieve.

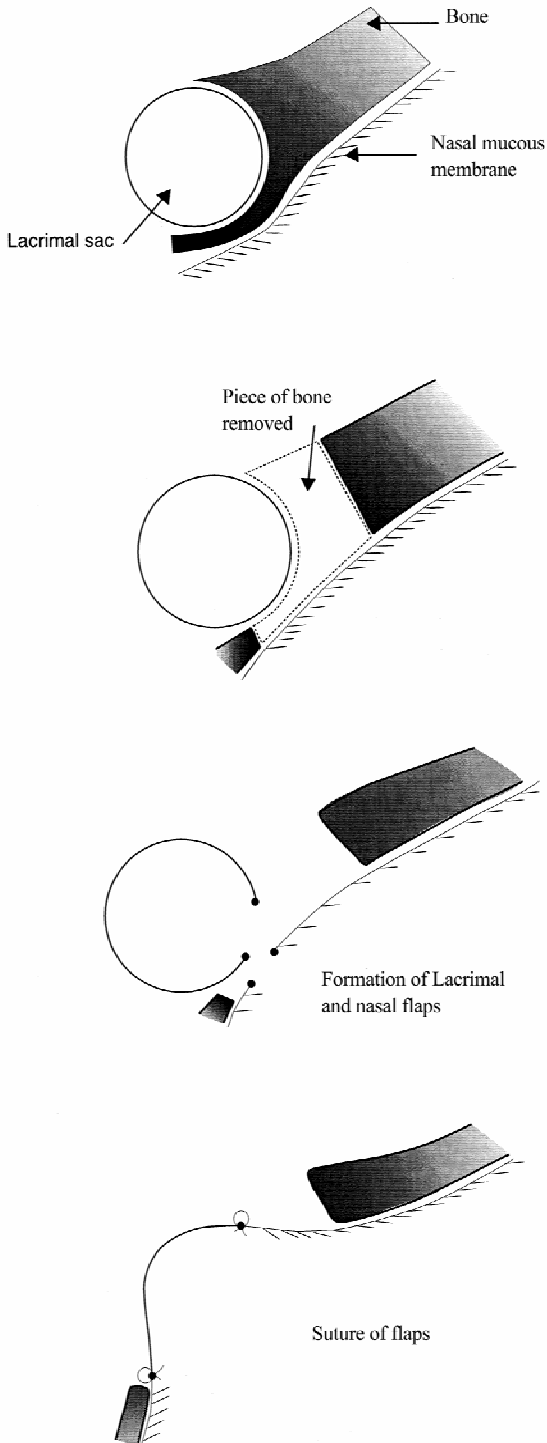


Fig. 9.10 A diagram in cross section to show how to perform a dacryocystorhinostomy

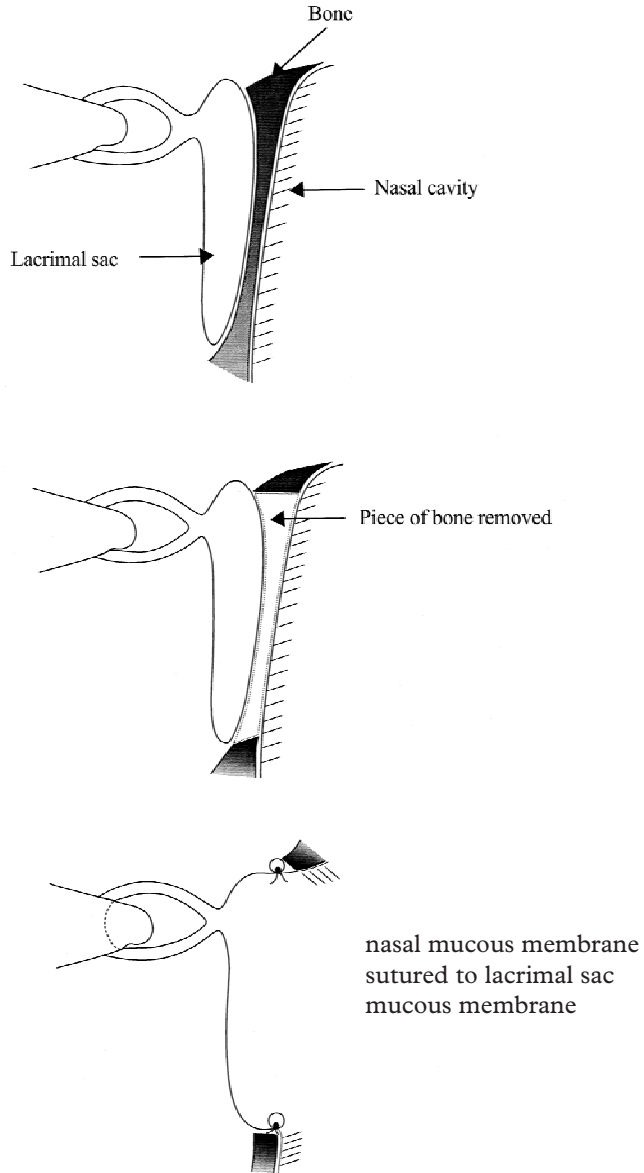


Fig. 9.11 A diagram in vertical section to show how to perform a dacryocystorhinostomy



*Principle:*

The aim of the operation is to remove part of the lacrimal crest and all the thin bone separating the lacrimal sac from the middle nasal meatus (fig. 9.12). The mucosa of the lacrimal sac is then joined to the nasal mucosa so it forms part of the lateral wall of the nose (figs. 9.10 and 9.11).

*Method:*

First check that the patient is not hypertensive because of the risk of excessive bleeding.

1. *Anaesthetic.* If the operation is under local anaesthetic the nose should be packed with ribbon gauze soaked in a mixture of 2 to 4 % lignocaine with adrenaline. This helps to vasoconstrict the very vascular nasal mucous membrane. (If available cocaine 4% is both a local anaesthetic and a vasoconstrictor). The pack in the nose must be inserted above the inferior turbinate bone and into the middle meatus of the nose. To do this the pack should be pushed upwards in the nostril. It is an easy mistake to push the pack backwards below the inferior turbinate bone into the inferior meatus, so it does not reach the correct area in the middle meatus of the nose, which is above the inferior turbinate bone.

Local anaesthetic with adrenaline should be injected over the lacrimal crest and both the infratrochlear and infraorbital nerves blocked (see fig. 9.6).

If the operation is under general anaesthetic the nose should still be packed with adrenaline because this lessens bleeding during the operation. Placing the patient with head slightly elevated on the operating table also helps to lessen the bleeding.

2. *Skin incision.* (See fig. 9.6). This should be medial to the bony ridge of the lacrimal crest. (The incision for dacryocystectomy in fig. 9.6 is just lateral to the lacrimal crest.) It should start at the level of the medial canthus and pass downwards and slightly laterally for 2 to 3 cm. The incision should not be over the lacrimal sac itself as this might damage it.
3. The incision is deepened down to the periosteum of the bone over the lacrimal crest and any bleeding from the angular facial vein is stopped with ligature or diathermy. This can bleed quite heavily. The skin flaps can be retracted by "cat's paw" retractors held by an assistant. Alternatively a self retaining retractor can be used or sutures can be placed in the wound edges and traction placed on the sutures with artery forceps secured to the drapes.
4. The periosteum, which is a thin fibrous sheet over the surface of the bone, is then divided and the rest of the dissection carried out on the surface of the bare bone and underneath the periosteum (fig. 9.13). This is a safe tissue plane where no damage can be done to the lacrimal sac or to any blood vessels or nerves. At the top of the incision the medial canthal tendon can be seen as shining white fibres and it is separated from its insertion into the medial wall of the orbit. The periosteum is incised with a knife starting at the insertion of the medial canthal tendon and passing downwards, staying just medial to the anterior lacrimal crest. Dissect the periosteum off the bone with a periosteal

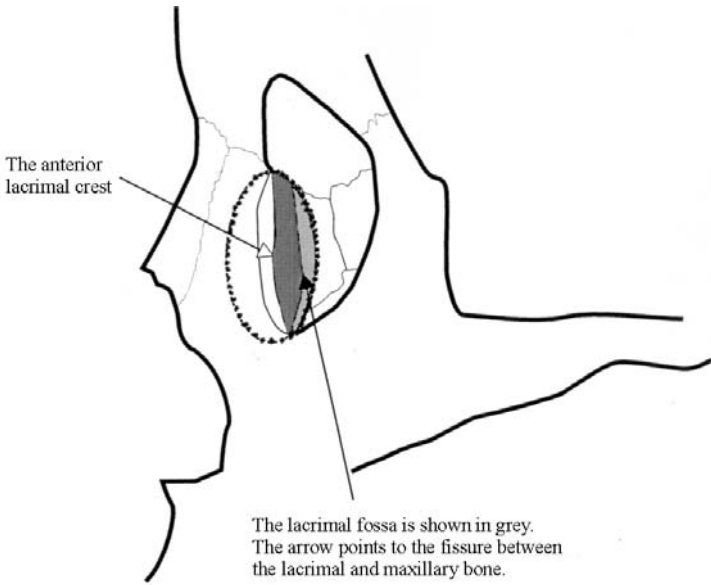


Fig. 9.12 The dotted line shows the bone removed for a dacryocystorhinostomy. This is the floor of the lacrimal fossa and the anterior lacrimal crest, and some bone in front of it.

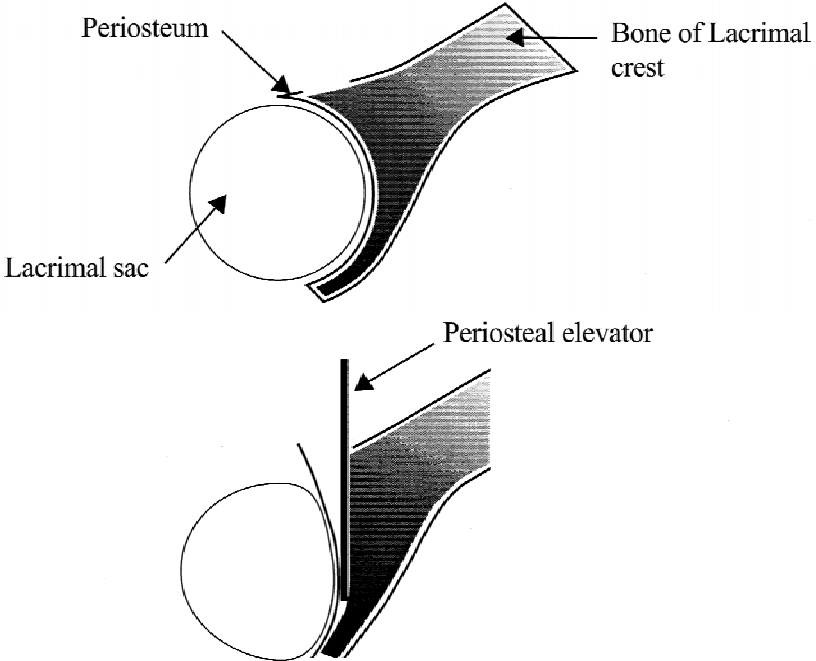


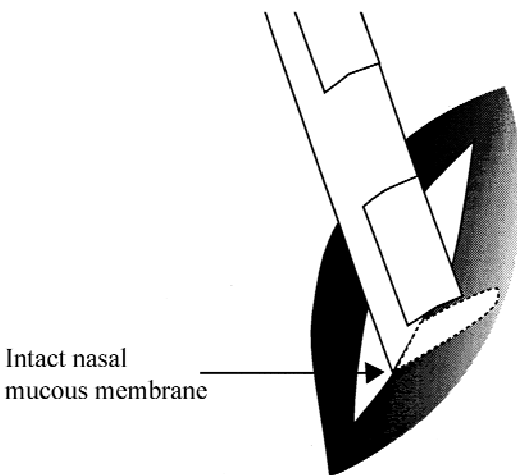
Fig. 9.13 To show how the periosteum is elevated and stripped off the bone of the lacrimal crest and the lacrimal fossa

elevator, moving towards the sharp lacrimal crest and then down into the lacrimal fossa, still separating the periosteum from the bone. Take great care to keep the periosteal elevator always just under the periosteum and right on the surface of the bone. The lacrimal crest can have quite a sharp angle and the dissection continues backwards to the floor of the lacrimal fossa.

5. The next stage is to remove the bone of the anterior lacrimal crest and the bone at the floor of the lacrimal fossa which separates the lacrimal sac from the nasal mucous membrane (see figs. 9.10 to 9.12). There are various ways of doing this:

#### *Method A*

In the floor of the lacrimal fossa there is a thin vertical bony fissure, where the maxillary bone joins the lacrimal bone (fig. 9.12). Force a bent Traquair periosteal elevator into this suture line and enlarge the opening enough to allow the jaws of a bone punch through the hole. Use the Traquair's elevator to separate the nasal mucous membrane from the inside of the bone and to push it away from the bone. Then use a small bone punch to remove all the bone of the lacrimal fossa and the anterior lacrimal crest. Take great care to preserve intact the nasal mucous membrane which may easily get caught in the tip of the punch (fig. 9.14). To avoid catching the nasal mucous membrane in the punch, first take the local anaesthetic pack from the nose so that nasal mucous membrane is not being pushed outwards. Also advance the punch very carefully so it just catches the bone and does not catch the nasal mucous membrane. Also use the Traquair's elevator as described. Bone removal should continue until an area the size of a finger-tip has been removed. This should be about 1.5 cm in diameter and should include all the bone of the lacrimal fossa and the anterior lacrimal crest.

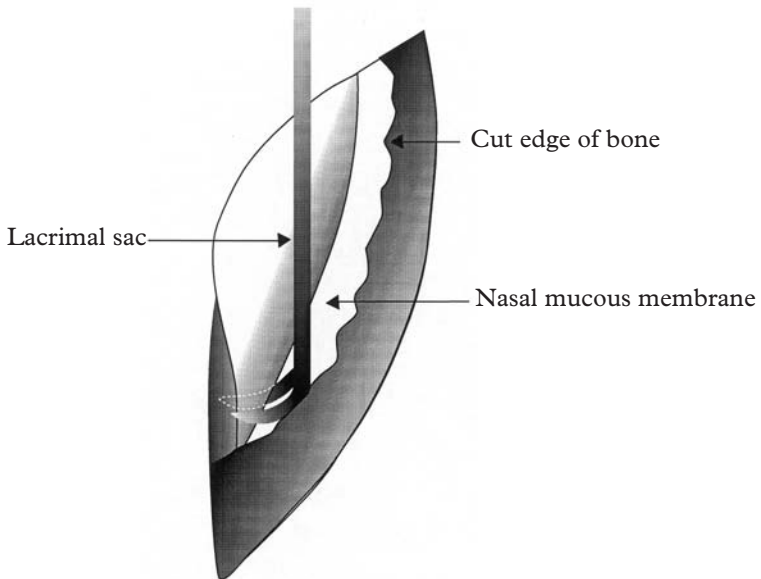


*Fig. 9.14* The use of the bone punch to remove the bone

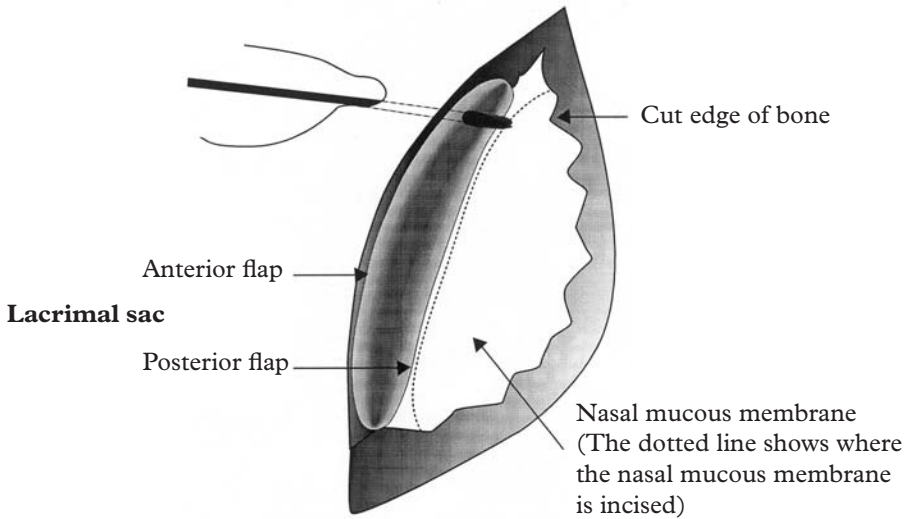
*Method B*

If the fissure between the maxillary bone and the lacrimal bone cannot be found or if there is not a good sharp bone punch available, a small chisel or osteotome or a circular bone drill should be used to remove the bone. It is best to remove a small piece of bone to include the lacrimal crest at first and then enlarge the hole in all directions. By holding the chisel tightly and by making gentle taps with the hammer it is possible to ensure that the chisel cuts through the bone without going on to cut into the nasal mucous membrane underneath the bone. Some surgeons prefer to use a small round drill to make the first opening in the bone. These usually come in pairs, one has a central spike and the other does not (see fig. 9.9c page 279). First use the one with the central spike to mark a round groove on the bone, and then the other one to penetrate through the bone. As soon as one feels the pressure of the bone beginning to become less, then stop drilling to avoid damaging the nasal mucous membrane.

6. The flaps of the lacrimal and nasal mucosa are now prepared. These should now be lying next to each other because all the bone separating them has been removed. First the naso-lacrimal duct is cut through at the lower end of the lacrimal sac using the small right angled scissors (fig. 9.15). Then by inserting one blade of the scissors into the sac and the other blade outside the sac, the medial wall of the sac is opened up from the bottom to the top forming an anterior and a posterior flap. Confirm that the lacrimal sac has been properly opened by passing a lacrimal probe down from the punctum along the canaliculus (fig. 9.16). The tip of the probe will appear in the opened up lacrimal sac. If right angled scissors are not available then a scalpel blade and



*Fig. 9.15* Use of right angled scissors to divide the naso-lacrimal duct



*Fig. 9.16* The lacrimal sac has been opened up and a probe inserted into the sac

straight scissors can be used, but scissors with a small right angled bend make this delicate part of the dissection easier.

The nasal mucous membrane must now be opened. Hopefully it is still intact but sometimes the process of bone removal may have made a small hole in it. Cutting the nasal mucous membrane is easier if it is put under slight tension by placing a curved artery forceps or the tip of the sucker up the nostril so it presses the mucous membrane outwards into the space from where the bone has been removed. The nasal mucous membrane should be incised to make a large anterior flap but only a small posterior flap (See the dotted line in fig. 9.16). The reason for this is the anatomical relationship between the lacrimal sac and the nasal mucous membrane. fig. 9.10 shows how the posterior part of the lacrimal sac is very close to the nasal cavity but the anterior part is separated by quite a large width of bone. Therefore the anterior nasal mucous membrane flap must be large to bridge this gap.

7. The lacrimal sac and nasal mucous membrane flaps are now sutured to each other. The posterior flaps should be lying very close to each other and there is usually little or no need to suture them. They are right down at the bottom of the incision and access is in any case difficult. It is important to suture the anterior flaps with at least two sutures. Absorbable material is best but if this is not available fine non-absorbable sutures can be used. A very curved needle makes the access and suturing of the flaps much easier. Try to keep the anterior and posterior flaps well apart so that the lacrimal sac drains well into the nose. This may be helped by tying the sutures of the anterior flap to the orbicularis oculi muscle so as to pull the anterior flap forwards.
8. Wound closure. The subcutaneous layers should be sutured if possible with interrupted absorbable sutures, and the skin closed. Post-operatively some

people advise packing in the nose but providing it is not bleeding excessively it is best not to pack the nose for several reasons:

- it is uncomfortable.
- it may cause the very delicate mucosal anastomosis to break down.
- when the pack is removed after 24 hours it may then provoke bleeding.

9. Postoperatively the skin sutures should be removed after 5-7 days. Antibiotic drops or ointment should be applied to the conjunctiva, and if the lacrimal sac is particularly infected a short course of systemic antibiotics is probably advisable.

The biggest problem during dacryocystorhinostomy is bleeding. This is often worse under general anaesthetic than local anaesthetic. In order to minimise bleeding during surgery it is essential to pack the nose well and pack it correctly so that the middle meatus above the inferior turbinate bone is vasoconstricted. It is also essential to stop all bleeding from the angular vein and its branches before proceeding with the rest of the operation. Slightly raising the head of the operating table will also diminish bleeding both under local anaesthetic and general anaesthetic. A good sucker is essential for a dacryocystorhinostomy.

In recent years there has been considerable interest in alternative methods of relieving dacryocystitis without open surgery. A dacryocystorhinostomy operation can be performed endoscopically through the nose without making any skin incision. Alternatively it is possible to have a balloon dilatation of the obstructed nasolacrimal duct by passing a very fine catheter down the duct and then using high pressure to rupture the obstruction. However, both these operations require expensive equipment, and the results even in the best of hands are still no better than a dacryocystorhinostomy operation through the skin.

There is an alternative and simpler method of dacryocystorhinostomy. It is worth considering if the facilities are not available for a standard dacryocystorhinostomy, and the surgeon is unwilling to destroy the lacrimal drainage passages by a dacryocystectomy. The aim of the operation is to insert a short flanged plastic tube from the lacrimal sac into the nose to by-pass the obstructed naso-lacrimal duct. The long term success rate is only about 50%.

### *Method:*

1. The anaesthetic blocks are the same as for dacryocystorhinostomy.
2. The lacrimal sac is exposed as for dacryocystectomy and then cut open from its front surface.
3. A trocar is used to make a hole through the floor of the lacrimal sac and the thin lacrimal bone into the middle meatus of the nose (fig. 9.17).
4. A short flanged plastic tube is then forced tightly and securely into this hole (fig. 9.18). This tube can be made from firm plastic tube which is heated and pressed against a flat surface to create a flange.
5. The anterior wall of the lacrimal sac is closed with one or two catgut sutures and the skin sutured.

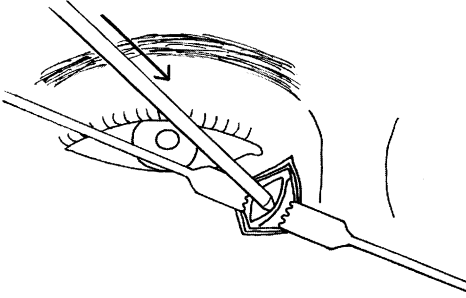


Fig. 9.17 Pushing a trocar through the floor of the lacrimal sac and bone into the nasal cavity

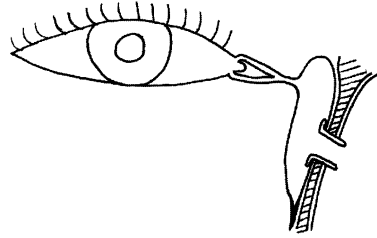


Fig. 9.18 To show the position of the flanged tube

### Obstruction of the common canaliculus

An obstruction here can only be relieved by a standard dacryocystorhinostomy operation and passing a soft silicone tube down the lacrimal canaliculi into the nose. The silicone tube has a short silverprobe at each end. These are passed down each canaliculus and into the opened up lacrimal sac after stage 6 of the dacryocystorhinostomy. They are then passed down into the nose and the two ends of the tube tied to each other, and the ends cut short.

### Lacrimal Punctoplasty

Obstruction or stenosis of the lower lacrimal punctum is easy to cure with a punctoplasty procedure. Punctal stenosis should be suspected if the patient complains of epiphora, but after dilating the punctum and syringing the nasolacrimal passages there is a free flow of fluid down to the nose. (Sometimes the punctum does not rest against the eye due to ectropion. In such a case an operation to correct the ectropion is necessary).

The aim of the operation is to open up the punctum by excising a triangle on its posterior surface facing the globe of the eye.

#### *Indications:*

Stenosis or occlusion of the punctum. The rest of the lacrimal passages must be patent for the operation to succeed.

#### *Method:*

1. Inject local anaesthetic with adrenaline around the lower punctum.
2. Dilate the punctum with a punctum dilator.
3. Insert one blade of very fine scissors into the punctum with the other blade in the conjunctival sac. Make a vertical cut about 2 mm long (fig. 9.19b)
4. Again insert one blade of fine scissors into the canaliculus and cut medially (fig. 9.19c).
5. Make a third cut so as to excise a triangle of conjunctiva opening out the punctum on to the posterior surface of the lid (fig. 9.19d).

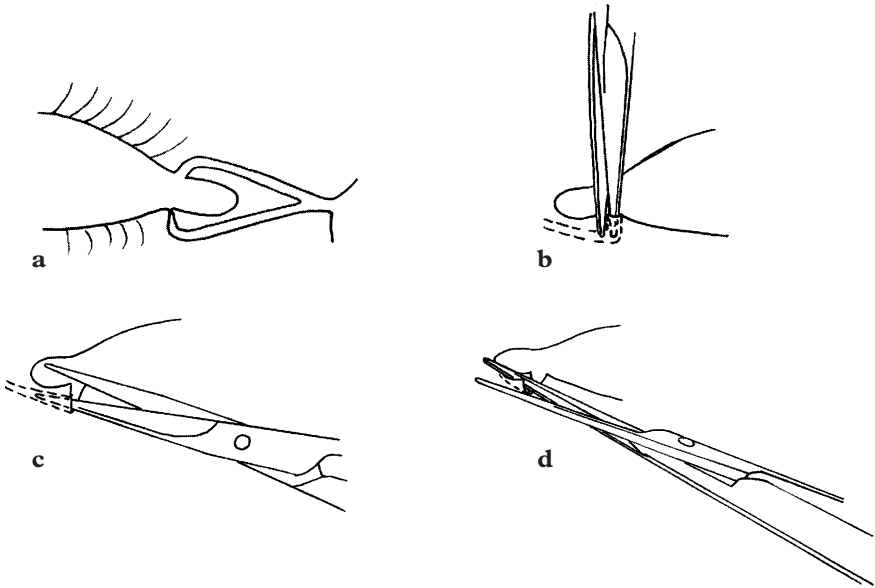


Fig. 9.19 The lower eyelid is seen from its conjunctival (posterior) surface and a small triangle of conjunctiva excised to open up the punctum

### Occlusion of the lacrimal punctum for dry eye patients

There are some patients who do not have enough tears, particularly patients with chronic rheumatoid arthritis. Their symptoms are often considerably helped by blocking off their lacrimal passages to preserve the small amount of tears that they have. This can very easily be done by using a cautery to seal off the lacrimal punctum. First inject local anaesthetic near the lacrimal punctum. Then dilate the punctum and pass a small cautery deep down into the punctum and turn the cautery on. This will burn the mucosa inside the punctum and seal it off permanently. Both the lower and the upper punctum should be sealed off in this way.