Chapter 12

Conjunctivodacryocystorhinostomy with the Insertion of a Jones Tube

12

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Core Messages

- Conjunctivodacryocystorhinostomy (CDCR) with the insertion of a bypass tube is a procedure in which a new lacrimal route from the conjunctival sac into the nasal cavity is created and a drainage tube is inserted between the inner canthus and the nasal cavity.
- The CDCR is carried out only in the canalicular obstructions if there is not any other surgical procedure available.
- Despite that minimally 50–60% of patients require replacing a tube within 5 years, the success rate of the procedure varies from 80 to 90%.
- The best thing seems to be Pyrex glass tube, which is used most commonly.
- The tube is considered a life-long prosthesis. If a Jones tube is extruded or lost, the recurrence of symptoms and the opening of the closure can be observed in the course of a few days because of the tunnel's non-functioning.

Contents

Table 12.1. Conjunctivocystorhinostomy with bypass tube

Tube placement (timing)
Primary placement (extensive canalicular obstruction)
With external DCR (EXT-DCR)
With endonasal DCR (EDCR)
Secondary placement
(after failed canalicular surgery with DCR)
Closed placement with endonasal monitoring
after failed DCR
Tube replacement
Location of the tube
Precanalicularly (caruncle)
Transcanalicularly (lower eyelid, medial to the punctum)

12.1 Introduction

Conjunctivodacryocystorhinostomy (CDCR) with the insertion of a bypass tube (Table 12.1) is a procedure in which a new lacrimal route from the conjunctival sac into the nasal cavity is created and a drainage tube is inserted between the inner canthus and the nasal cavity (Fig. 12.1). The tube in place is considered a life-long prosthesis. The procedure is mostly indicated if the upper and lower ipsilateral canaliculi are completely obstructed [11, 23]. The success rate of the procedure varies from 80 to 90% [24].

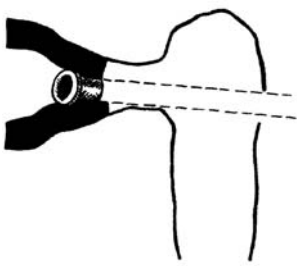

Fig. 12.1. Total lower and upper canalicular obstructions with Jones tube insertion. (From [14])

The canalicular obstructions, especially a proximal canalicular obstruction, represent a problematic and therapeutically the most difficult part of lacrimal surgery. In the medial canalicular obstructions and/or common canaliculus obstructions, a proximal patent part of canaliculi can be used for the lacrimal system reconstruction, e.g., canaliculodacryocystorhinostomy; however, it is usually not possible to use canaliculi for the reconstruction in proximal canalicular or complete canalicular obstructions. Many attempts have been made for the relief of the proximal canalicular or extensive canalicular obstructions (see Table 11.2) to produce an epithelial lined tract between the conjunctival sac and the lacrimal sac and nasal cavity, ethmoidal, or antral sinus [11, 21]. The conjunctival flaps have been pulled towards the lacrimal sac and/or the mucosa or grafts of veins have been pulled towards the conjunctiva and/or grafts of veins or the mucosa has been used. Those operations were called lacodacryostomy, lacoductostomy, conjuctivorhinostomy, conjunctivocystorhinostomy, or conjunctivodacryocystorhinostomy, and at present they are rarely performed (Fig. 12.2). The main disadvantage of those techniques is, despite this new epi-

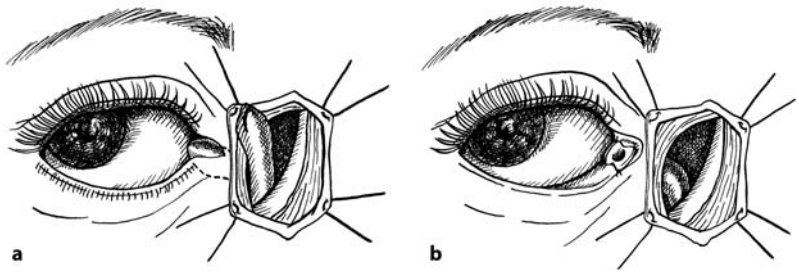

Fig. 12.2. Transposition of a lacrimal sac in a canalicular obstruction. **a** External conjunctivocystorhinostomy with the transposition of lacrimal sac. **b** Lacrimal sac is fixed in the medial canthus. (From [14])

Table 12.2. Etiology of extensive canalicular obstructions

Canalicular trauma
Radiotherapy
Congenital punctal and canalicular agenesis
Infections (herpes simplex zoster, chlamydia, trachoma, etc.)
Cytostatic therapy (5-fluorouracil)
Following medial canthal tumor excision with extirpation of lacrimal system
Following failed canalicular and other lacrimal surgery
Idiopathic

thelial-lined tract opened for syringing, the patients are not usually free of epiphora due to non-functioning of the lacrimal pump [21].

A glass bypass tube between the conjunctival sac and the nasal cavity was used for the first time in 1925 by J. Heermann, a German otorhinolaryngologist. The tube was inserted through the lower canaliculus [4, 9]. In the ophthalmology literature this procedure is connected with the name of Lester Jones, who described the surgery in 1962. While Heermann used an endonasal approach for the procedure, Jones used an external approach and this technique has prevailed for many years. The procedure is known as Jones' conjunctivodacryocystorhinostomy or dacryocystorhinostomy + bypass tube, conjunctive dacryocystorhinostomy, or dacryocystorhinostomy + Jones tube [11–14].

The renaissance of endonasal approach has been widely accepted for lacrimal surgery since the 1980s with the advent of new instruments: rigid fiberoptic endoscope and techniques for endoscopic sinus surgery, with which the procedures can be performed easily and safely. The nasal endoscopy in CDCR enables to perform dacryocystorhinostomy, placement of a tube, and adjunctive intranasal procedures such as a middle turbinectomy or septoplasty. Endoscopy is helpful in the maintenance of a tube, which is often the most challenging and critical aspect of the procedure. The choice of endoscopic vs external CDCR, however, remains that of the lacrimal surgeon guided by his or her surgical experience and the specific surgical case at hand [27].

12.2 Indications and Contraindications

12.2.1 Indications

The following indications are in effect:

1. Less than 8 mm of patent canaliculus from punctum, i.e., an extensive proximal canalicular obstrucion, acquired or congenital, that cannot be used for a canalicular reconstruction. The agenesis of lacrimal punctum with no punctal papillae can be included in this group because of non-developing or maldeveloping the canaliculi and the sac.
2. Severe trauma to the upper and lower canaliculi proximally. Attempts to reconstruct canalicular lacerations have failed.
3. Failed canaliculodacryocystorhinostomy or other canalicular surgery.
4. Severe canalicular stenoses.
5. Tumors of the inner canthi following dacrycocystectomy and canaliculectomy.

12.2.2 Contraindications

The following contraindications are in effect:

1. Patency of the lacrimal system is a principal contraindication for the placement of a bypass tube; however, in severe canalicular stenosis CDCR can be the only effective procedure.
2. Lid malposition is a relative contraindication. A reconstruction of the traumatic eyelid malposition is supposed prior to Jones tube placement. The proper eyelid closure is important, not only for drainage function but also for the fixation of a tube. If there is an orbicularis weakness, e.g., in patients with facial nerve palsy, the performance of surgery is expected to be much worse due to non-functioning of the lacrimal pump and orbicularis. It is because the effect of blinking and lid functioning for drainage function with a bypass tube is fundamental. According to our experience, it is better to make the indication in those patients very carefully.

3. Age of patient is a relative contraindication for reasons of postoperative care and poorer cooperation in small children [24]. We assume the lowest age for the procedure to be 12 years.

12.3 Case History

Canalicular infections and a trauma of the eyelids and medial canthal area are typical causes of the canalicular obstruction. Canalicular obstructions can also appear following radiotherapy, systemic cytostatic therapy, etc. The cause of canalicular obstructions, however, is not often revealed and stenosis or complete obstruction is often found without etiological determination [11, 24].

There are a lot of surgical procedures and surgical modalities used in the therapy of the canalicular obstructions, e.g., laser canaliculoplasty, DCR, CDCR, canaliculocystorhinostomy, silicone intubation, etc. A choice of the optimal procedure depends on the location of the obstruction, its length, and the length of the proximal patent part of canaliculi. Their determination is an essential diagnostic problem [7].

A CDCR is to be performed if the upper and lower ipsilateral canaliculi are completely obstructed. While it is no problem to measure the length of proximal patent part from the punctum to the obstruction with simple probing, it is difficult to determine the status of canaliculus distal to the obstruction. It can be guided only by probing and exploration with retrograde probing via the common canalicular opening; however, the external approach is required and it is not easy to perform it in practice [22]. A dacryocystography and retrograde canaliculography with the injection of the contrast medium into the lacrimal sac can be used, but only theoretically. In addition, the results of canalicular surgery in proximal obstructions are controversial, and that is why a CDCR with a Jones tube placement is mostly preferred in proximal canalicular obstructions [11].

12.4 Nasal Examination

The nasal examination should be performed prior to lacrimal surgery to prevent potential problems [22, 30]. It is important especially prior to a CDCR with the external approach, because there it can be difficult to solve unexpected intranasal problems during the operation, e.g., bleeding.

There are some anatomical findings which can lead to a drainage failure: middle turbinate position and significant septal deviation. Limited turbinectomy (resection of the anterior part of the middle turbinate) is to be performed by otorhinolaryngologist in all CDCRs to prevent tube dislocation and its obstruction with the nasal mucosa. Septoplasty should be performed in significant septal deviation and/or if some problems after surgery are expected [22, 29]. If the endonasal approach is used for a DCR prior to a tube-closed placement, the partial turbinectomy is performed by otorhinolaryngologists in one sitting.

12.5 Instrumentation: Drainage Bypass Tubes

Tubes of different materials have been used for the procedure (polyethylene, silicone, Teflon, polypropylene, and glass). The materials of tubes should be of some special qualities, i.e., they should not be porous and hydrophobic and must have some rigidity so that they do not collapse and no reaction in the surrounding tissues causes arises. The best thing seems to be Pyrex glass tube, which is used most commonly (Fig. 12.3). We have our personal experience with silicone and glass tubes, and we found the latter much more convenient (Weiss Scientific Glass Blowing Co., Portland, Ore.).

Tubes can be straight or curved. Better drainage is along a straight tube than a curved tube, which is supposed to reduce the tube migration and improve positioning. Pyrex glass tubes have ocular flanges, measuring 3.0, 3.5, and 4.0 mm, and the tubes have a gentle nasal flange. The outer diameter is 2.5 mm along the shaft of the tube and inner diameter is 1.5–1.7 mm. The length of the tubes varies from 9 to 25 mm. The straight tubes 14–17 mm long are used most commonly according to our experience.

The stability of a tube is insured with an ocular and a nasal flanges. It prevents the tube from migration medially; at the nasal end, the tube gradually flares to a 2.8-mm diameter, which prevents lateral displacement of the tube [23]. Nevertheless, the extrusion of the tube is a common complication [11, 20]. To prevent migration, the tubes with small suture holes at the junction of the head and neck of a tube can be used. Glastone and Putterman reported using

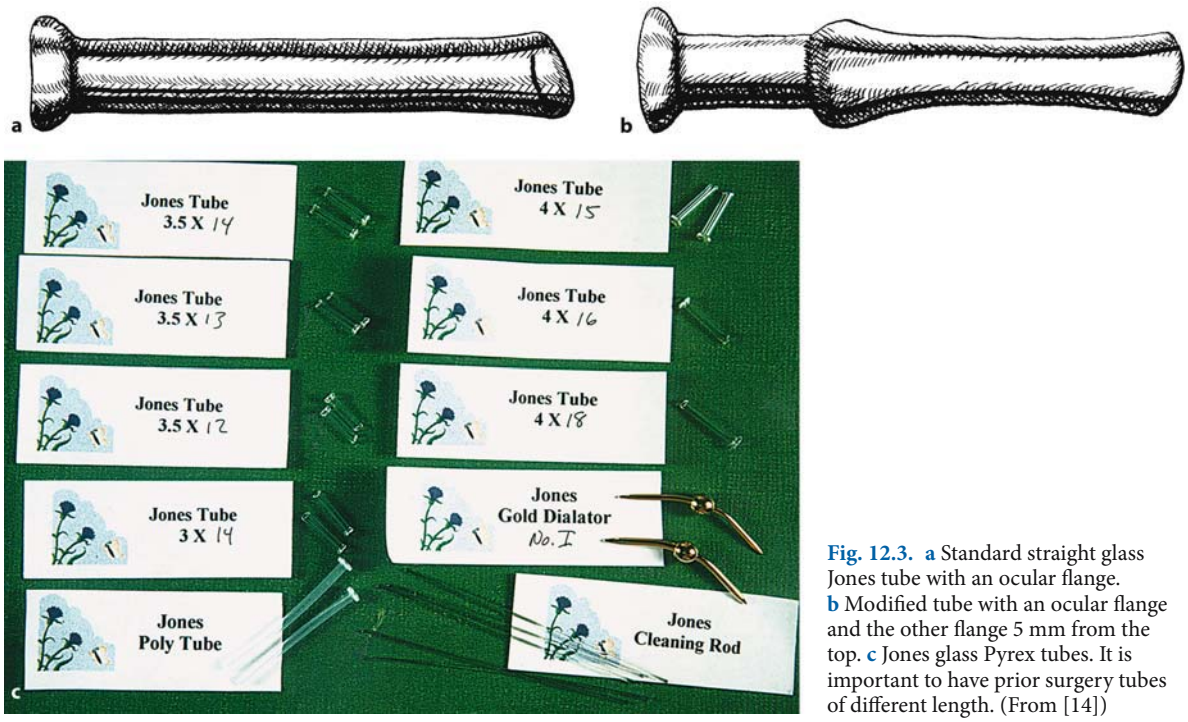

Fig. 12.3. **a** Standard straight glass Jones tube with an ocular flange. **b** Modified tube with an ocular flange and the other flange 5 mm from the top. **c** Jones glass Pyrex tubes. It is important to have prior surgery tubes of different length. (From [14])

of the tube with a flange in the middle of the tube, which helps to stabilize a tube [6, 20, 23]. The modified tube has another flange, measuring 3.2 mm placed 3–6 mm from the top flange.

12.6 Anesthesia

A CDCR can be performed under general anesthesia or under local anesthesia with or without any sedation. We prefer general anesthesia with tracheal intubation in all patients under the perfect airway control, not only in young, uncooperative, nervous, and anxious patients. General anesthesia allows a peaceful performance of the procedure, which is comfortable for the patient and the surgeon as well. It is important in all procedures that can be complicated with bleeding, which is usually the major problem, and it concerns a CDCR as well. The modern medications used for general anesthesia provide safe conduct of anesthesia and surgery without or with a minimum of postoperative side effects.

Bleeding is the major complication in a CDCR. To decrease this complication, the vasoconstriction of the nasal mucosa is performed. As the procedure is performed similarly to the other endonasal sinus procedures, the vasoconstriction is performed in the same way:

1. A nasal spray or drops of oxymetazolin is used preoperatively. Before the surgery, two applications of 0.1% solution are administered to the nasal cavity during a half an hour.
2. The pledglets soaked with 1:10,000 epinephrin (2–5 ml) are placed in the nasal cavity shortly after intubation.
3. The lateral nasal wall and middle turbinate are injected with 2–4 ml of 1% trimecain + 1:100,000 epinephrin and the pledges soaked with 1:10,000 epinephrin are placed in the nasal cavity again. After satisfactory anesthesia and nasal decongestion are achieved, i.e., after 5–10 min, the operation starts.

12.7 Operative Technique

12.7.1 Terminology

The main aim of a CDCR is to bypass the lacrimal system altogether and to create a new conduit for tear outflow [22, 27]. This is done by careful positioning a small tube between the tear lake at the region of the caruncle and the middle meatus just anterior to the middle turbinate [27].

The procedure consists of two steps: dacryocystorhinostomy (DCR) and tube placement.

If both of those steps are performed in one sitting, the tube placement is called primary placement. In the secondary closed placement, a tube is placed in the separate sitting, whereas the DCR is performed prior the placement.

A CDCR with Jones tube placement as originally described by Jones has traditionally been performed as an "open" or external procedure by way of a medial canthal incision [27]. The external approach is preferred mostly by ophthalmologists, but in the past two decades the endonasal approach has been more frequently by otorhinolaryngologists who are familiar with endonasal sinus surgery [14, 22]. The endonasal approach is especially advantageous in secondary tube placement after failed canalicular surgery with DCR, in which a bone window had been done [27].

The tube can be placed precanalicularly (caruncle) or transcanalicularly (lower eyelid, medial to the punctum). The medial canthal or caruncle placement is used more often. It is usually necessary to remove part of the caruncle; however, the stability of a tube is better and a shorter tube is used. The transcanalicular placement can be used if there is a wide lower punctum. A tube is placed in the posterior lamella of the eyelid [24]; however, it is important to use a longer tube and there is a greater tendency for the tube to fall out [22].

12.8 Primary CDCR with Jones Tube with Endonasal Approach

The procedure consists of two steps: endonasal dacryocystorhinostomy and tube placement.

12.8.1 Endonasal Dacryocystorhinostomy

After satisfactory anesthesia and nasal decongestion are achieved, the lacrimal sac projection is located intranasally. The sac projection is expected to be at the junction of the superoanterior attachment of the middle turbinate to the lateral nasal wall. Using bayonet forceps assists the orientation (see Tips, Tricks, and Alternatives, Chapter 12.11).

The anterior part of the middle turbinate is resected with scissor or forceps (Fig. 12.4). Hemorrhage can be stopped with electrocautery, if necessary. The mucous membrane above the frontal process of maxilla in front of the head of the middle turbinate is incised, elevated, and removed (approximately 1.5×1 cm) with endonasal sinus surgery forceps and the bone is exposed medially to the lacrimal sac.

12.8.1.1 Bone Window

The bone lying medially and anteriorly to the sac is mostly removed with using chisel and hammer and/or drill the sac to be widely opened to the nasal cavity. The anterior ethmoid cells have to be removed in some cases to achieve it, too.

It is important that the bone window be wide enough for the bone not to push later on a glass tube. If a surgical drill is used for a bone removal, care must be taken not to cause a zone of bone necrosis. So, simultaneously irrigation and suction must be done. The edges of the bone window can be palpated in the medial canthus from the outside. If the bone window is not wide enough, especially in the inferomedial direction, it must be widened and a tube can be then inserted.

12.8.1.2 Sac Opening

The sac is incised with a sickle knife and opened and the medial wall of the sac is removed or the mucosal flap of the lacrimal sac can sometimes be placed posteriorly to keep the sac widely opened.

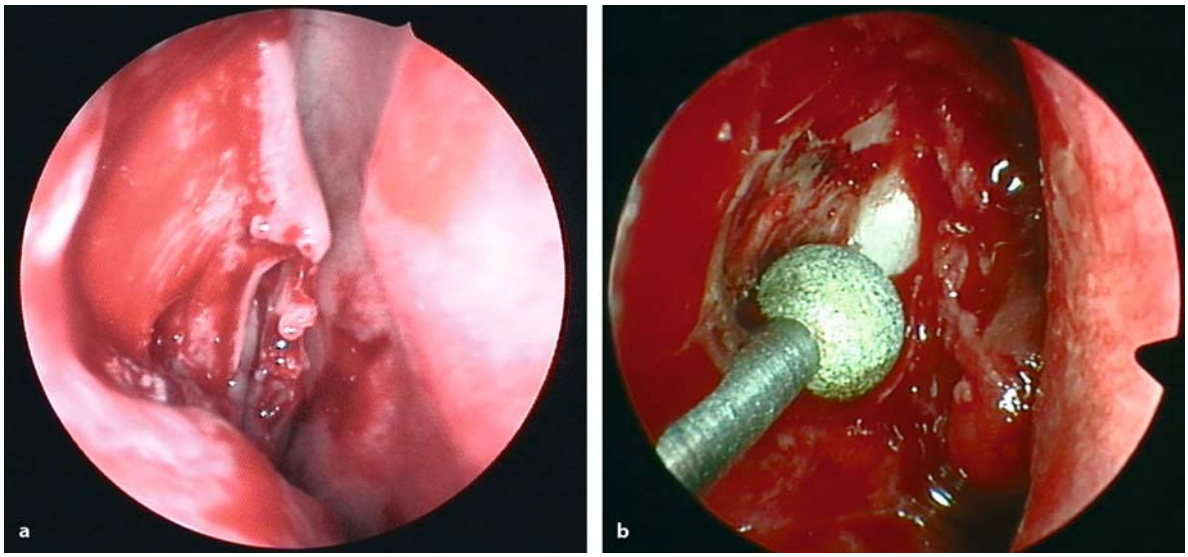

Fig. 12.4. Dacryocystorhinostomy is carried out as an initial part of the procedure. It can be performed from the endonasal or external approach. **a** Removal of anterior portion of middle concha (*right*) prevents postoperative complications. **b** The bone is removed with the help of drill (shown), chisel, or laser

12.8.2 Tube Placement

The following steps are taken for tube placement:

1. Caruncle bipolar electrocautery is performed prior the tube placement to reduce the caruncle (Fig. 12.5). It gives a better access to the entry at the medial canthus. Electrocautery is preferred to cutting a caruncle because it makes hemostasis, and the conjunctiva has a less tendency to cover later the tube.
2. A needle (or a guide wire) is passed in the medial canthus from the site of the caruncle (or anterior/inferior caruncle) into the nasal cavity in the inferomedial direction. Viewing endonasally with Hopkins endoscope can confirm that the needle positioning is correct and the length of the tunnel can be measured.
3. The tunnel is cut with the help of a Graefe knife along a needle into the nasal cavity through the soft tissues while the cornea is preserved with a protector (Fig. 12.6). The opening of the tunnel can be enlarged with moving the knife inferiorly and then superiorly, if necessary (the knife end is pushed and pulled with short movements in superior and inferior directions to enlarge the track) and its intranasal positioning can be confirmed endoscopically.

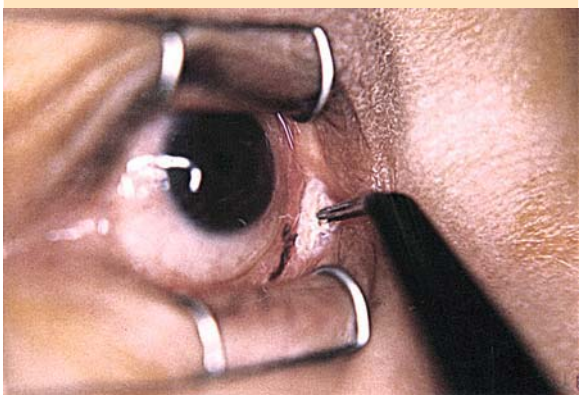

Fig. 12.5. Electrocautery of the caruncle gives good access to the entry at the medial canthus. (From [14])

Fig. 12.6. **a** Tunnel is cut with Graefe knife in an inferomedial direction from inner canthus into the nasal cavity. **b** Tube is inserted with Tiemann catheter pulled through the tunnel. **c** Jones tube is fixed with a suture to the lower eyelid. (From [14])

12.8.2.1 Length of a Tube

A tube should be approximately 2–4 mm longer than the length of a tunnel, because success of the procedure depends on accurate positioning of the tube. The tip of the Graefe knife is controlled endoscopically to be 2–4 mm over the lateral nasal wall and the edge of the knife is grasped at the medial canthus with a hemostat of tweezers and the Graefe knife is then withrawn. This process provides a measure of the distance from the medial canthus to the knife tip and the determination of an appropriate length of the tube [20].

11.8.2.2 Tube Insertion

A tube is inserted with the help of Thiemann urological catheter, the outer diameter of 8 Charrier, or with a guide wire. A Jones tube is put into the luminous end of Thiemann catheter not farther than 2 mm. The catheter tip is put into the cut tunnel from the caruncle and the catheter placement is controlled endonasally with endoscope. The tip is caught with forceps and pulled out of the nose and thus a glass tube is gently inserted into the tunnel. At this moment the flange of the tube is fixed with forceps in the medial canthus and the catheter is drawn out of the tube. The correct placement of a tube and its length are controlled endoscopically.

12.8.2.3 Tube Fixation

The tube is fixed with a Prolene suture 8-0 around its neck to the medial part of the lower eyelid. The suture is removed in 4–6 weeks. A Jones tube with a hole at the neck makes suturing easier.

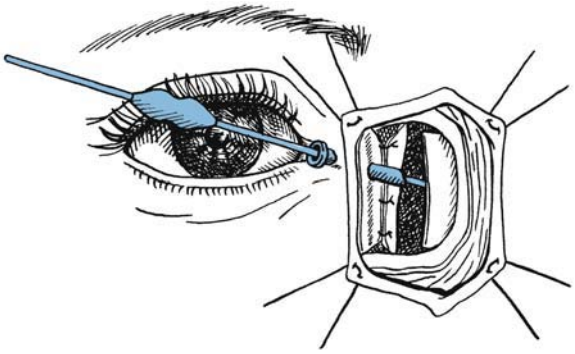

Fig. 12.7. The CDCR with an external approach. Tube is inserted into the tunnel after the posterior nasal and lacrimal sac flaps were anastomosed. (From [14])

12.9 External vs Closed Approach

Most reports of CDCRs have described an external approach (Fig. 12.7) [28].

The primary CDCR with external tube placement starts with a standard DCR with the incision on the side of the nose. The tube is placed after posterior lacrimal sac and nasal flaps are anastomosed. If the tube position is definitely good, the anterior lacrimal and nasal flaps are sutured [11–13].

The endoscopic closed CDCRs have been also performed in past years because endoscopic visualization is critical in the placement of the Jones tube [22, 27, 28]. The advantages of endoscopic CDCR are the same as those cited for DCR, i.e., lack of cutaneous scar, shorter operation time, and blood loss [7, 28]. An endoscopic approach allows the surgeon excellent intranasal visualization to perform a middle turbinate resection and to assess the proper length and positioning of the tube. The technique for endonasal surgery is much more expensive than the equipment for a traditional external CDCR; however, this fact has lost its importance because the equipment necessary for endoscopic CDCR is now readily available in most hospitals and ambulatory surgery centers [27]. That is why an endonasal approach is used more frequently than it was 20 years ago.

As in the revision DCR, the endoscopic approach is favourable in the setting of a revisions procedure, i.e., in secondary tube placement, which provides superior intranasal visualization [11, 22, 27, 28]. The choice of external or endonasal endoscopic CDCR remains up to the lacrimal surgeon, guided by surgical experience [28].

12.10 Secondary Tube Placement

The secondary tube placement is performed if DCR failed and with canalicular surgery. The tube placement is easier to perform because of less hemorrhage and more consistent (solid) tissues between the medial canthus and nasal cavity following surgery and the bone window was carried out in previous surgery. A tube can be placed if the bone window has been made wide enough for the tunnel to be performed.

The procedure is performed under general or local anesthesia and the tube is placed in the same manner as the primary procedure.

12.11 Tips, Tricks, and Alternatives

There are some points which can make some troubles in the procedures, especially tube insertion and tube stability, which can be influenced by many factors such as the distension of the tunnel, its direction, choice of the tube, its fixation, etc.

12.11.1 Lacrimal Sac Location

The lacrimal sac cannot be located with the help of transcanalicular translumination due to the canalicular obstruction. That is why the intranasal orientation during the procedure need not be easy, especially for beginners.

Using nasal bayonet forceps is useful for the orientation in locating a lacrimal sac projection (Fig. 12.8). One jaw of the forceps is placed extranasally and held in the medial canthus. The other jaw placed intranasally accords with the lacrimal sac projection on the lateral nasal wall and indicates the place to look for the lacrimal sac. This procedure can be easily repeated during the surgery [17].

12.11.2 Direction of the Tunnel

It is advisable to direct the tube in the infero-medial direction, i.e., 30–45% inferiorly. If the tube is hori-

Fig. 12.8. Lacrimal sac location. Intranasal orientation is easier with bayonet forceps to locate lacrimal sac projection. One jaw is held in the medial canthus. The other jaw placed intranasally accords with the lacrimal sac projection on the lateral nasal wall

zontal, its stability is worse and there is a higher risk of tube extrusion. The inferomedial direction is important for the drainage function because gravitation plays an important role in tear drainage [21, 24].

12.11.3 Insertion of the Tube

Tunnel should be appropriately wide so that the fit between the tube and the tunnel should minimize postoperative extrusion [10]. If the tunnel is too wide, a worse stability of the tube is received and its extrusion is supposed. On the other side, an overly tight tunnel makes insertion of a tube difficult.

In standard Jones procedure a bypass tube placement passed over the Bowman probe is described as being inserted into the tunnel (Fig. 12.9a). We were using this technique in the primary closed placement when we started performing CDCR procedures; however, we found that it had been difficult sometimes to place a tube down the tunnel because the nasal end of the glass tube is a little wider than the outer diameter and often draws up soft tissues of the tunnel in front of it and makes placing more complicated. In spite of using the Bowman probe or Kirschner wire, tube insertion can be very stressful. In those cases the tube insertion can be achieved by slight traction on the margins of the opening or the tube is aided by rotation of it with forceps or by widening the tunnel; however, it can cause tube migration and its loss. [10].

The troubles with the tube insertion were the reason for using the Thiemann urological catheter [16]. The Tiemann cathether tip is slightly hooked, ball shaped, fluently extended in its diameter, is sufficiently hard (but not as much as the wire), and it enables distension of the tunnel, which need not be too wide.

A similar principle of the tube placement uses vessel dilator recommended by Gonnering [7, 8, 22]. The vessel dilator is cut 4 cm from its distal end and

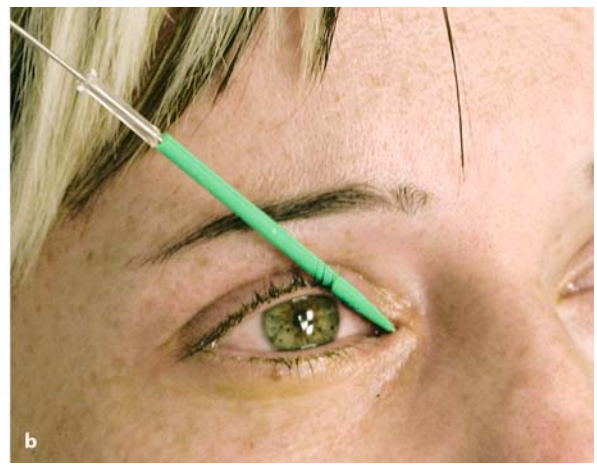

Fig. 12.9. **a** Closed tube insertion of Jones tube placed over Bowman probe. If the tunnel is appropriately wide, the tube insertion can be achieved by slight traction on the margins of the opening or the tube being rotated with forceps. **b** Tube insertion with vessel dilator. Tube is placed over a guide wire

threaded over the guide wire and the Jones tube is threaded on the guide wire behind the dilator segment [8]. The dilator ahead of the Jones tube is confirmed intranasally and the Jones tube is placed into the tunnel tightly behind the dilator (Fig. 12.9b). The vessel dilator and guide wire are then both removed from the nostril [8]. We have experience only with a few procedures performed in this manner.

The trephine, described by Henderson, can achieve optimal tunnel to make the tube placement accurate [10]. A core of the soft tissues is cut with the trephine and the tube is introduced on the guide wire so that it enables better positioning and stability of the tube [10, 22]. We do not have experience with this technique.

If a wire is passed transcanalicularly, it is passed into the nose from the lower canalicular ampulla (opened by a three-snip procedure).

12.11.4 Length of the Tube

The tube must not be either very long nor very short. A long tube may extrude proximally and the nasal lumen can be obstructed with the mucosa of the septum or the turbinate. A short tube can be overgrowth with the nasal mucosa especially if it migrates laterally.

The distal nasal end should be 2–4 mm over the nasal wall, minimally 2–3 mm from the septal mucosa [11, 19, 24]. An optimal tube can be replaced later, if necessary; endonasal telescope assists in the visualization and correct positioning.

12.11.5 Fixation of the Tube

The fixation of a tube with a suture around its collar significantly decreases a risk of its extrusion and loss [19, 23]. Since we started to do it, the extrusion rate and migration have been observed less frequently. Can observed less extrusion after insertion of the Jones tube circumscribed with a buccal mucosa graft [2].

12.11.6 Nasal Pathology

Nasal pathology, including septal deviation and impacted middle turbinates, are factors in failures with the Jones tube [29, 30]. These conditions can be handled prior to the insertion of the tube, if recognized. An otolaryngological consultation should be performed and surgery on the nose, if indicated, should be done prior to the insertion of the CDCR.

If there is a significant septal deviation, it is better to perform septoplasty prior the lacrimal surgery [30]. If we hesitate, we recommend doing it, according to our experience, to avoid postoperative problems.

The anterior tip of the middle turbinate is sometimes found to obstruct the inner end of a tube. If the middle turbinate is allowed to remain in place, contact with the glass tube can cause bleeding, discharge, and pain. The tube may change its position, irritating the eye, and ceasing to function [29]. We recommend to perform the resection of the anterior tip of the middle turbinate in all CDCRs because it decreases postoperative complications.

12.12 Highlights

The CDCRs have their limits and not all patients with canalicular obstruction are suitable candidates for surgery. The tube placement is permanent, i.e., a long-life prosthesis. It differs significantly from a temporary silicone intubation in DCR or canaliculocystorhinostomy. If a Jones tube is extruded or lost, the recurrence of symptoms and the opening closure can be observed in the course of a few days because of the tunnel's not functioning. There are only rare cases in which the opening may be left open and the patients are free of symptoms.

A DCR is a highly successful procedure, especially in patients 20–69 years [25]. A reported success rate of Jones tube placement with relief of epiphora varies between 41 and 100% (according to experience, it is 85–90%) [7, 14]; however, a high success rate is associated with a significant number of complications, much higher than after DCR. [2, 3, 11, 14, 22, 24]. That is why a postoperative follow-up period may in fact require more than one surgical procedure to reach that point. In addition, 15–20% of the patients are expected not to be satisfied with the results despite the good functioning of the procedure. The postoperative care and the number of follow-up examinations, tube maintenance, fogging and spraying of spectacles, and discomfort may contribute to a patient's satisfaction despite a completely dry eye [18]. The patients have to be informed preoperatively that CDCR cannot guarantee a comfortable, dry eye, and

that a lot of complications can occur in tube maintenance in the long term is necessary [11, 25]. It can prevent their dissatisfaction and frustration.

That is why very good motivation and good cooperation are the basic conditions for the surgery. It is important to discuss all alternatives with a patient before the procedure and again immediately after the surgery to explain the nature of the operation, its goal, and limitations and the commitment to a long period of frequent postoperative follow-up examination [11, 18, 25]. The patients must be prepared for a possibility of secondary surgery. This explanation may reduce dissatisfaction resulting from overly high expectations [24].

12.13 Postoperative Care and Complications

12.13.1 Postoperative Care

12.13.1.1 The Follow-up Examination

It is advisable to perform examinations 1 week, 1 months, 3 months, and 6 months after surgery and later minimally once a year. [18]. The patients are recommended to return for a review if problems with the tube occurs.

The examination includes an inspection of a position of the tube, fluorescein dye disappearance test, the sniff test (see below), and endonasal endoscopy. The postoperative function can be evaluated by using a FDT viewed directly (Fig. 12.10). Endonasal endoscopy is fast and efficient and facilitates the maintenance of a tube function with a minimal manipulation and patient discomfort, including a inspection of the length and a position of the glass tube [1]. That is why close cooperation between ophthalmologists and otorhinolaryngologists is needed.

12.13.1.2 Care Immediately After Surgery

Applying steroid-antibiotic drops is recommended for 1 week. The patients are recommended to wet their nose with sprays and lavages. They should not blow the nose for 4–5 days, and only if necessary, and only very gently, because emphysema can occur. Patients are allowed to blow the nose later; however, to prevent the tube extrusion (Table 11.3), the tube must be protected with holding a finger over the medial canthus and/or the patient must close the eyes tightly. It is important to show it to the patients and to explain it and check if they know how to do it. Patients must be instructed not to wipe their eyes but only pat them towards the nose to avoid a extrusion of the tube.

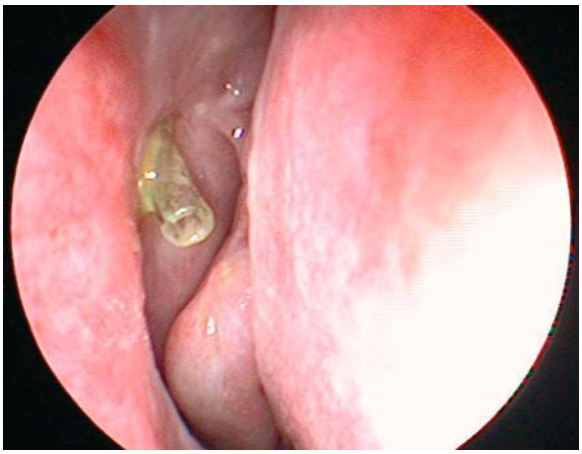

Fig. 12.10. Nasal cavity and the proper tube position a few weeks after surgery (*right*)

Table 12.3. Prevention of tube extrusion

Interomedial direction of the tunnel (tube)
The tunnel is not to be very wide
Suturing of a tube with the skin (eyelid)
Puttermann modified tubes with a double flange
Blowing one's nose with closed eyelid or with a finger over the medial canthus
Angled glass tubes

12.13.1.3 Cleaning a Tube

A tube has to be cleaned every day in the morning to be patent. Tube maintenance is often the most challenging and critical aspects of CDCR. The tube is cleaned with the sniff test: the patient is told to splash some water in the conjunctival sac, to hold the other nostril, and to sniff (snort) water from the medial canthus into the tube and the nose. The air and water pass down the tube, and this rash can be acoustically noticed by the patient (sniff test).

12.13.1.4 Blowing One's Nose

As there is a greater risk of lateral tube migration and loss, it is not recommended to blow the nose without closed eyelids or holding the tube with a finger. It is important to check the patient's ability to perform this maneuver at visits. Sometimes the tube can be plugged with a lot of mucous discharge. Some decongestant eyedrops can be used and the tube cleaned with the same technique. Some patients would be able to clean the tube with a probe, if necessary, but we do not recommend it.

12.13.2 Complications

12.13.2.1 Extrusion of the Tube

One of the most frequent complications is an extrusion of the tube, which can happen in many patients [18, 24]. Minimally 50–60% of patients require replacement of a tube within 5 years [11, 14, 22].

An extrusion may occur immediately following surgery, however, in postoperative surgery it does not occur very often despite the fact that the tunnel and some fibrous tissue stabilize the tube and hold it in place.

Hypermobility of the Jones tube can be prevented in the immediate postoperative period by suturing the tube in place at the time of surgery with a 6-0 nonabsorbable suture wrapped several times around the tube near the collar [20]. The suture is left in place for 3 weeks while the tissue contracts around the tube (Fig. 12.6c). The modified tube with a double-flanged tube helps to anchor the tube in the surgical passageway and reduces its hypermobility [20].

12.13.2.2 Tube Replacement

The extrusions immediately after the surgery are usually caused by the bad fixation with a suture or by a wrong position of a tube. It usually causes no problems to reinsert the tube into the tunnel under local anesthesia shortly after the extrusion.

A Weiss gold dilator or some other dilator can be used for it, too. A tube is usually put over the Bowman probe and inserted into the opening in the medial canthus and secured with a suture; however, it is not easy to dilate the tunnel and to insert a tube if the tunnel is too contracted and scarred, and it can be unpleasant and painful (Fig. 12.11). The longer the time after the extrusion, the more complicated the reinsertion. We use wire dilators and it is advantageous to monitor an optimal length of the tube and its nasal positioning with the help of an endoscope.

Fig. 12.11. Replacing Jones tube. Dilator opens and dilates the existing tract

12.13.2.3 Malposition (Migration) of the Tube

Migration is a common complication. There are lateral and medial migrations. Lateral migration can be observed if the septum or middle turbinate is pushing the tube laterally or it can be caused by cicatrix formation at the lateral nasal wall. It can be caused by hypertrophy of the middle turbinate, too, and the turbinectomy is usually needed if it has not been performed. We recommend to perform resection of the anterior tip of the middle turbinate in all CDCRs. Since we started fixing the tubes with a suture to the eyelid, we have seen this complication only rarely.

Medial migration usually indicates that the tube is too short. It can be removed and a slightly longer one can be substituted [7]. Medial migration is relatively common following the Jones technique in which a large track is cut, and is less common with the trephining technique [23].

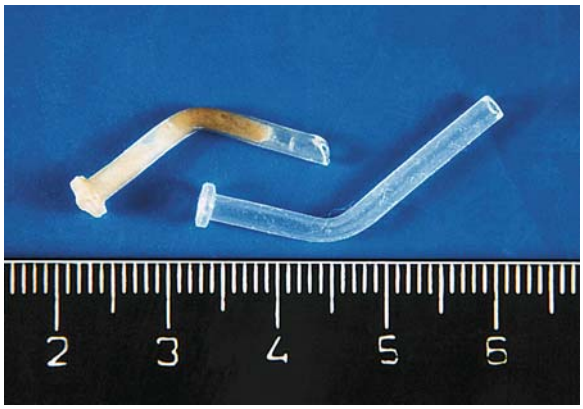

Fig. 12.12. Obstruction of a silicone curved tube (*above*), below the new one. (From [14])

12.13.2.4 Plugging the Tube

Plugging with the mucus stopper can mostly set in if the patient has not been adequately looking after the tube. It can be observed extremely rarely in patients with glass tubes and very often in patients with curved silicone tubes (Fig. 12.12). If the tube cannot be cleaned with the sniff test, it can be sometimes better to remove the tube, to clean it is carefully, and reinsert it. Obstruction of the tube by mucus plugging can be easily rectified by cleaning and syringing the tube in an outpatient setting [18].

12.13.2.5 Granulations

Granulations may be seldom formed at the ocular end of a tube coming from caruncle or conjunctiva, but they can sometimes grow over the ocular end. A small granulation can be resected with scissors under local anesthesia [30]. In some recalcitrant granulations it may be necessary to remove the tube and reinsert it after healing. We have observed such a situation only once.

The nasal end can be grown over with a granulation as well or the mucosa membrane if a tube is too short. This can be prevented with a longer tube.

12.13.2.6 End Impact

End impact on middle turbinate or septum leads to partial or total loss of function and causes intractable pain [26].

12.13.2.7 Bleeding

Bleeding after a CDCR seems to be similar to a DCR and usually causes no problems, especially for otolaryngologists who are familiar with the endonasal procedures and surgery [27]. Bleeding can be solved with the nasal packing (it is usually used at the end of the procedure), or with nasal decongestive drops. The surgeon must be careful not to push the packing on the tube at its nasal end and to push it laterally.

12.13.2.8 Breaking the Tube

Breaking the tube is theoretically possible but extremely rare. We have not observed it thus far.

12.13.2.9 Conjunctivitis

After CDCR, the conjunctival flora of the eye becomes similar to the nasal flora [3]. Conjunctivitis can be present as a result of a mild infection around the collar of the tube. It presents as a foreign body sensation and it can be treated with antibiotic steroid drops [30]. Late conjunctivitis is usually a result of scale-like deposits which have collected on the outside of a Pyrex tube and the tube should be removed and cleaned [30].

12.14 Conclusion

A proximal canalicular obstruction can be treated with conjunctivocystorhinostomy + Jones tube placement. The procedure should be used if no other reconstruction procedures can be performed. As a high number of complications, much higher than in DCR, are observed in the postoperative period, a very good motivation should be a basic condition for successful surgery.

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