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Lacrimal Trauma in the Adult

By Jeffrey Jay Hurwitz, MD, FRCSC

According to the Canadian Ophthalmological Society, at least 100 000 Canadians experience an accidental eye injury annually.[1] Data from the United States Eye Injury Registry indicate that almost one-third (31%) of eye injuries are caused by a blunt object, followed by a sharp object (18%) and motor-vehicle accident (9%).[2] In the November/December 2008 issue of *Ophthalmology Rounds*, Drs. Kim Jebodsingh and Dan DeAngelis discussed pediatric oculoplastics trauma, which included canalicular lacerations.[3] Canalicular lacerations in children are often very different from those occurring in adults with respect to etiology, diagnosis, and management. This edition of *Ophthalmology Rounds* will discuss lacrimal trauma in the adult.

Lacrimal trauma in the adult may be divided into 2 groups: canalicular trauma (soft tissue) and sac/duct trauma (bony fracture).

Adult Canalicular Trauma

Canalicular trauma in the adult may be due to either a laceration from a sharp or blunt object or to an avulsion, with or without a skin laceration, where the canaliculus is pulled apart. In any patient presenting with a lower-lid laceration regardless of whether the canaliculus is involved, it must always be determined whether a piece of the eyelid is missing or not. A piece of missing eyelid may be sterilized and sewn back into its original position. If the missing piece cannot be found, then the eyelid can be repaired with flaps or grafts, as is done in the reconstruction following removal of an eyelid tumour.

Presentation

The patient with an eyelid laceration usually presents to the emergency department, but may present to the clinic or office. Many eyelid lacerations occur in conjunction with excessive alcohol consumption, as well as due to falls, particularly in frail and/or elderly patients. If surgery is being contemplated, evaluate the patient's general status. Determine if the laceration needs to be repaired, when it should be repaired, and whether it can be repaired in the office, minor operating room, or the main operating room in the hospital. Identify if both canaliculi are blocked, or whether the common canaliculus has been avulsed.

The reasons for repairing a canalicular laceration are functional and cosmetic. From a functional point of view, one must determine whether tearing would be a problem if the canaliculus was not repaired, and whether further surgery might be necessary. It is important to remember that tear secretion decreases with age; tear secretion at age 80 is only 20% what it is at age 20 (Figure 1).[4] Therefore, an older patient may not experience tearing even if the canalicular laceration was not repaired.

Physiological factors

Tears flow through both the upper and lower canaliculus. Approximately 50%–60% of tears flow through the lower canaliculus, and 40%–50% through the upper canaliculus.[5] However, there is a great deal of interpatient variability with respect to these figures. For tears to flow through the canaliculi, there must be integrity of the punctum, punctal apposition to the opposing eyelid, ampulla integrity, and a normal functioning lacrimal pump. Flow through the canaliculi depends on blinking and it is well known that in a case of facial

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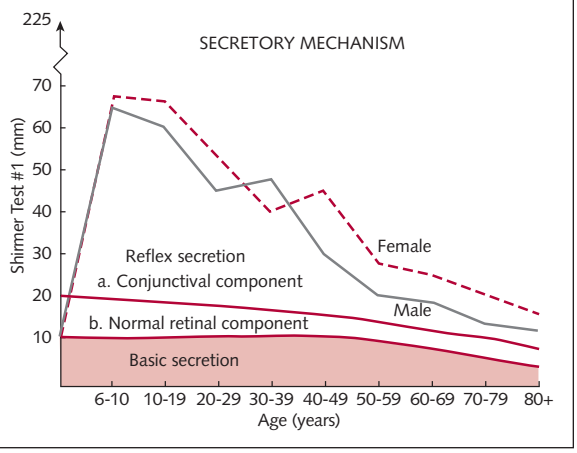
Figure 1: Secretion of tears declines exponentially with age.[4]



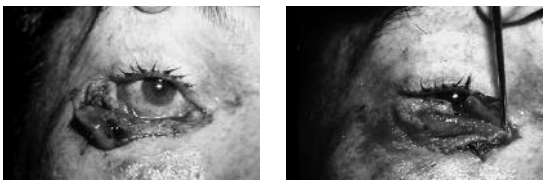
paralysis, tears may not flow out of the palpebral aperture despite the fact that the lacrimal system is patent and anatomically normal.

Patient evaluation

Once the patient has been evaluated systemically, attention can be focussed on the ocular and periocular structures. Once it has been ascertained that there is no problem with the globe, one must examine the lacerations. If a laceration is present through the eyelids medial to the puncta, a canalicular laceration should be suspected. A rounding of the medial canthal angle may also suggest an avulsion of the common canaliculus (Figure 2). An attempt should be made to grasp the pieces of the torn eyelid to see whether they can be pulled back into position and ultimately sutured (Figures 3a-b). Irrigation should then be performed through each punctum to see if there is patency to the nose. If there is transection of the canaliculus (Figure 4), an attempt must be made to find the medial cut end of the canaliculus so that repair can be instituted. In a lower canalicular laceration, irrigation through the upper canaliculus may drain out through the medial end of the lower canaliculus as well as into the nose. Irrigate with either saline, water with air bubbles, fluorescein-tinted viscoelastic, or steroid eye drops which

Figure 2: Patient with lower canalicular laceration and rounding of the medial canthus.

Figures 3a-b: Patient with lower canalicular laceration and lacerations through the lower eyelid before (a) and after (b) the pieces of the eyelid are pulled back into position.



are white in colour. Fluorescein-tinted viscoelastic has the added advantage of tinting the medial cut end of the canaliculus.

Timing of surgery

If the patient is intoxicated and uncooperative, there is no harm in waiting for a better time to make the repair, up to even a few days. Delaying intervention by at least a day after the injury, combined with use of ice compresses, allows the swelling to decrease and often results in the medial cut end becoming more avascular and visible at slit lamp or with operating loupes. In adults, we prefer to not perform these procedures in the middle of the night, but wait until all of the facilities are available and maximized during the day. If one canaliculus is lacerated in an adult, repair can usually be done in the office or minor operating room. If there is laceration to both canaliculi or to the common canaliculus, it is usually better to attempt to repair these patients in the operating room where a dacryocystorhinostomy (DCR) can be done as well if it is deemed that a canalicular reanastomosis to the sac must be performed.[6]

Canalicular repair

Anesthesia. Canalicular laceration repairs can usually be done in the office or minor operating room under local anesthesia. This is facilitated if one can see the medial cut end of the lower canaliculus on slit-lamp examination. The main operating theatre is usually not required unless there is a need to treat a

Figure 4: Cadaver specimen showing a laceration of the lower canaliculus. The instrument in the lower canaliculus identifies the medial and lateral cut end. There is also a syringe in the upper punctum.

lacerated common canaliculus, in which case conscious sedation or general anesthesia is necessary.

Finding the medial cut end at surgery. If the medial cut end cannot be found, one can pass a Worst pigtail probe from one canaliculus through to the other.[7] The use of these probes has been controversial, however, in that one does not want to damage the uninvolved canaliculus or common canaliculus while repairing a single canalicular tear. The reasons for this are 2-fold. First, if the laceration repair fails, many patients will have adequate tear flow through the uninvolved canaliculus, common canaliculus sac, duct, and into the nose so that they will be tear-free despite canalicular obstruction. Second, even if the patient experiences tearing after an unsuccessful lower canaliculus repair, it has been shown that in most cases a DCR alone will drain tears through the upper canaliculus into the nose without the need of a permanent prosthesis (ie, Jones bypass tube).[8] If one cannot find the medial cut end of the canaliculus on first pass with a pigtail probe (without a hole for a suture, and without a burr on the end), it may be best to abandon the canalicular repair and just suture the lower lid. This will put the lower lid in excellent apposition with the globe so that upon closure there is also excellent apposition with the upper lid. This will enable tear flow to occur through the uninvolved canaliculus.

Canalicular sutures. There has been controversy in the literature with respect to whether one should suture the ends of the lacerated canaliculus and/or insert a stent. It is advisable to try to suture the ends of the canaliculus that has been torn; 1–3 sutures of 7-0 or 8-0 gut or polyglactic material should be sufficient.

Stents. Mono- or bicanalicular stent tubes may be used. A bicanalicular stent is more difficult to place in the office or minor operating room and often may require a general anesthesia. There is also the risk that the uninvolved canaliculus may be damaged in passing a bicanalicular stent. Bicanalicular stents will have a loop at the inner canthus and pass down into the nose (Figure 5). If one needs to use a pigtail probe, loop the bicanalicular stent through both the upper and lower canaliculus with a knot at the inner canthus, where the tubes are tied together. It is often useful to lasso a soft, nonabsorbable suture around the knot. The knot will sit at the inner canthus. This "annular" intubation can be useful, but the knot often irritates the eye. It is easier to leave a bicanalicular intubation in place for a longer period of time than it is for an annular intubation.

If the medial cut end can be found, a monocanalicular stent is much easier to insert. Monocanalicular stents are very useful and have a flange that fits into the punctum. The distal end of the tube can be cut so that it sits in the sac, without the need of pulling it down into the nose. These tubes can be left in place for many weeks, and are solid and do not drain tears. Hollow tubes made of Teflon®, which can drain tears, may be utilized. These tubes may be sutured to the punctum. However, these tubes are not commercially available.[9]

Combined upper and lower canalicular lacerations. An attempt may be made to pass monocanalicular stents through both the upper and lower canaliculi if the medial cut end(s) can be found. However, the medial cut end in an upper and lower canalicular laceration will tend to retract medially and be very difficult to find. Therefore, it is often better to do these procedures in the operating room where the sac can be opened and the medial cut end(s) may be more easily identified. These cases usually require a bicanalicular stent.

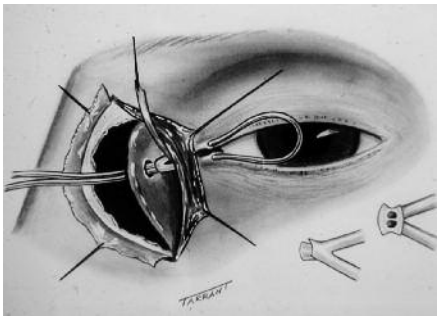
Common canalicular obstructions or avulsions. Patients with obstructions at the common canaliculus (Figure 6) usually need to be operated upon in the operating room so that an anastomosis can be made from the lateral aspects of the laceration(s) to the medial end(s). A DCR often is necessary in conjunction (Figure 7); this procedure is called a canaliculodacryocystorhinostomy.[10]

Total canalicular obliteration is very unusual in the trauma situation, unless a large segment of the medial canthus, including the upper and lower canaliculus, has been avulsed. In this situation, it is probably best to repair the lacerations with the view of inserting a Lester Jones bypass tube[11] either at the same time as the laceration repair (if there is minimal swelling), or at a later date (Figure 8).

Figure 5: Bicanalicular stent following a lower canaliculus repair.

Figure 6: A dacryocystogram showing an obstruction at the common canaliculus on the left side following trauma.

Figure 7: Diagram showing a double anastomosis: one between the common canaliculus and the sac, and the other between the sac and the nasal mucosa. Illustration courtesy of Mr. Terry Terrant.



Take-home message (Table 1)

In repairing a lacerated canaliculus, the repair is not urgent; the eyelid must be repaired meticulously. Direct suturing of the cut end of the canaliculus is advocated, as is the placement of a temporary stent. Stents should be left in place for at least 6 weeks, if possible, and optimally for 3 months. If one cannot repair a lacerated canaliculus, abandon the attempt and meticulously repair the eyelid. In this situation, many patients will have adequate drainage through the noninvolved canaliculus and not have problems with tearing.

Nasoethmoidal Fractures (Sac-Duct Tears)

Trauma to the nasoethmoidal region may be direct (tear or evulsion) or indirect (bone compression or tissue compression). The nasolacrimal duct runs from the nasolacrimal sac through the bony nasolacrimal canal into the inferior meatus (Figure 9). The patient often presents with multiple fractures, and it is important to determine whether the nasoethmoidal complex has been involved.

Figure 8: Diagram showing a double anastomosis: one between the common canaliculus and the sac, and the other between the sac and the nasal mucosa. Illustration courtesy of Mr. Terry Terrant.

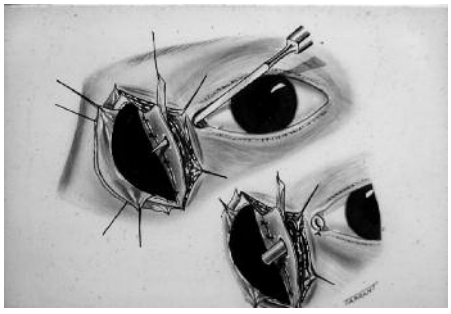


Table 1: Take-home messages

Canalicular repair

- Not urgent – repair lid
- Direct suturing
- Stent – monocanalicular, bicanalicular

Midfacial fracture

- Open reduction and internal fixation
- Pick bone off lacrimal system
- Intubate only if lacerated
- Wait 3-4 months for dacryocystorhinostomy

Patient examination

Patients suffering nasoethmoidal fractures often have had motor-vehicle accidents or other forms of severe trauma. Once the general medical status of the patient has been cleared, then repair is often undertaken. It is surprising, despite first appearance, how often the lacrimal system has avoided severe damage in these cases. Although it may usually be virtually impossible to identify the lacrimal system in some of these severe cases (Figure 10), it often is possible to identify the nasolacrimal duct and determine whether it has been torn (Figure 11). The presence of telecanthus is associated with a greater risk of a lacrimal evulsion with discontinuity of the lacrimal system.

Treatment of the lacrimal system

It is useful to pick the bony and soft-tissue fragments off the nasolacrimal canal to determine whether it has been transected. In cases of a transected nasolacrimal canal, it is reasonable to insert a bicanalicular stent through each canaliculus, through the ends of the laceration, and into the nose. However, the soft tissue of the lacrimal system is often very resilient and most of the time is not torn. Prophylactic intubation of the system

Figure 9: Diagram of the nasolacrimal drainage system showing the interosseous segment of the drainage pathways.

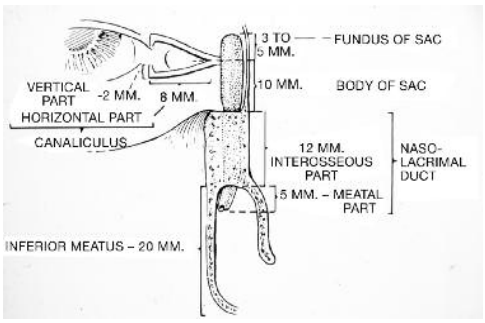


Figure 10: Surgical exposure of the face after massive trauma. Identification of the nasolacrimal system is a challenge.

can do more harm than good. A DCR is definitely not indicated in the acute situation.

Delayed treatment of lacrimal sac obstruction following nasoethmoidal trauma

Most of the time, the bony repairs have been done utilizing plates and screws. It is probably best to leave these in place for at least 4 months before they are removed, so that there will be no risk of misalignment of the bony skeleton. Dacryocystitis with accompanying blockage to syringing of the tear duct should be treated with antibiotics in the early phases, and only treat the patient conservatively and try not to operate for a few months after trauma repair. It is often useful to perform a dacryocystogram so that the position of the tear sac can be seen (Figure 12) and to identify the plates and screws that have been inserted (Figure 13).

Lacrimal repair may be performed by external or endonasal DCR. If an external approach is to be used, one must identify the hardware (Figure 14)

Figure 11: A midfacial fracture where it is possible to identify the nontransected lacrimal drainage system.

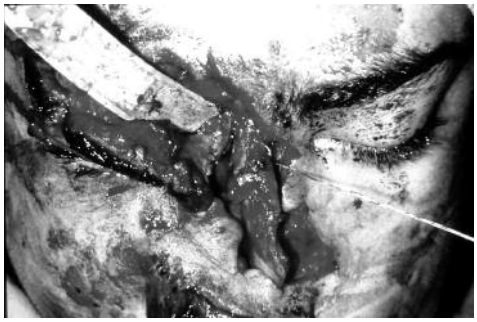


Figure 12: Dacryocystogram following facial trauma and repair with wires. The right lacrimal sac is displaced superiorly and laterally.

and often cut the hardware with an orthodontic wire cutter to allow access to the osteotomy and to perform mucosal anastomosis. A bicanalicular silastic stent should probably be left in place for approximately 3 months in severe cases. The success rate for DCR operations in the delayed state is extremely high.[12] Jones-tube insertion does not need to be performed unless there has been complete obliteration of both the upper and lower canaliculi.

An endonasal approach can be performed if there is "good" nasal anatomy, and if the sac is not too fibrotic. With an endonasal approach, there is no need to remove the regional hardware. A bicanalicular stent is also advised for approximately 3 months.

Take-home message (Table 1)

Midfacial fractures should be treated with open reduction and internal fixation with bones and other soft tissue fragments being picked off

Figure 13: Radiological identification of plates and screws following midfacial fracture repair.

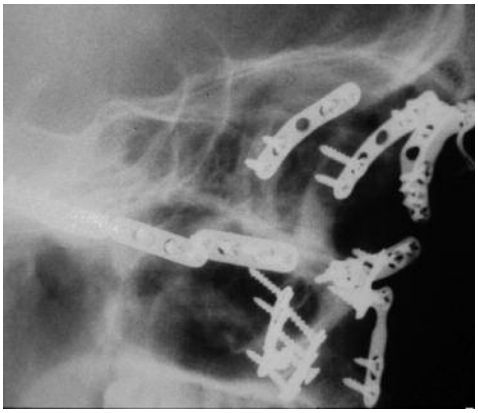


Figure 14: Identification of hardware (plates and screws) during external dacryocystorhinostomy.

the lacrimal system. The lacrimal system should only be intubated if it is lacerated. If the lacrimal system remains obstructed postoperatively, a DCR can be performed either through the external or endonasal approach at the optimum time of 3-4 months post-trauma repair.

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