

## Trauma of the Lacrimal Drainage System: Retrospective Study of 32 Patients

Brigita Drnovšek-Olup, Matej Beltram

University Eye Clinic, Medical Center Ljubljana, Ljubljana, Slovenia

**Aim.** To assess retrospectively the results and complications of surgical techniques applied in the treatment of patients with trauma of the lacrimal drainage system.

**Methods.** Out of 32 patients with lacrimal drainage system trauma included in the study, 25 were treated at the University Eye Clinic, Ljubljana Medical Center, Ljubljana, Slovenia, from 1999 to 2003, and 7 were referred for secondary repair from other health care institutions in the same time period. All patients with fresh injuries underwent surgery within 48 h. The patients were followed up to a year after surgery. We evaluated the function of the lacrimal drainage system by irrigation at the last follow-up visit.

**Results.** Patent lacrimal drainage system was achieved in all 25 patients with primary reconstruction of the injury. Restenosis of the canaliculus occurred in 4 out of 7 patients after secondary reconstruction.

**Conclusions.** Early repair of the lacrimal drainage system eliminates complications in comparison with secondary repair. Repair of the lacrimal drainage system may be delayed for up to 48 h, if an experienced operating team is available.

**Key words:** dacryocystorhinostomy; eye injuries; eyelids; lacrimal apparatus; lacrimal duct obstruction

The lacrimal drainage system consists of the superior and inferior lacrimal punctum, superior and inferior lacrimal canaliculus, common lacrimal canaliculus, lacrimal sac, and nasolacrimal duct. From their origin at the puncta, the canaliculi run medially and parallel to the lid margin towards the internal angulus of the eye, where they join into a common lacrimal canaliculus that opens in the lacrimal sac. The lacrimal sac is connected to the lower nasal meatus by the nasolacrimal duct. Elimination of tears from the eye occurs mainly by the tear pump (1,2).

Lesions of the lacrimal drainage system occur in up to 16% of all eyelid injuries (3). The main causes are dog bites, violence, and car accidents (3,4). Canalicular lacerations are the most common injury of the lacrimal drainage system because of their exposed location in the upper and lower lid (5). The lower canaliculus is more frequently involved (6). Lacerations of the lacrimal sac or nasolacrimal duct are often associated with severe head trauma and midface fractures. Iatrogenic nasolacrimal duct trauma can occur after endonasal surgical procedures (6,7).

Any injury of the lacrimal drainage system leads to scarring and stenosis, which in turn causes excessive tearing. Recurrent inflammation of the lacrimal sac occurs when the point of obstruction is in the lacrimal sac itself or below it (6,7).

The aim of our study was to revise the results of primary and secondary surgical repair of injuries to the lacrimal drainage system performed from 1999 to

2003 at the University Eye Clinic, Ljubljana Medical Center.

### Patients and Methods

We treated 32 patients for trauma or secondary post-traumatic reconstruction of the lacrimal drainage system over five-year period. Twenty-five patients had primary reconstruction and 7 had secondary reconstruction of the lacrimal drainage system. We divided the patients undergoing primary reconstruction into three groups, depending on the location of the lesion: 18 patients with a canalicular laceration, 5 with a lacrimal sac injury, and 2 with a nasal duct laceration. Seven patients underwent secondary reconstruction of canaliculi. All patients with fresh injuries were surgically treated within 48 h by use of an operating microscope (OPMI-VISU 200, Carl-Zeiss, Oberkochen, Germany). All patients with fresh trauma received prophylactic oral antibiotics. All patients received eye drops containing dexamethasone and neomycin 4 times daily for 10 days after surgery. All skin sutures were removed 5 days after surgery. We used silicone stents (Mini-Monoka, FCI, Issy-Les-Moulineaux Cedex, France) in all cases but one, where a prolene suture was used. The stents were removed 6-12 months after surgery (median, 8 months). The patients were regularly followed up for a year after surgery. We evaluated the function of the lacrimal drainage system on the basis of patient's medical history, slit-lamp examination, and irrigation of saline through the lacrimal canaliculi.

#### Canalicular Lacerations

We performed the reconstructions of canalicular lacerations in general anesthesia or with a regional nerve block of the anterior ethmoidal and infratrochlear branches of the nasociliary nerve with 2-3 mL of solution containing 2% lidocaine, 0.75% bupivacaine, and 1:100,000 epinephrine. The uninjured canaliculus was irrigated with fluorescein dye or yellow viscoelastic. A pigtail probe was inserted in case of doubt, to locate the proximal

end of the injured canaliculus. A monocanalicular or bicanalicular silicone stent or a prolene suture was placed after positive identification of the canaliculi through the distal and proximal end. We sutured the lacerated ends of the canaliculi with Vicryl 8-0 or 7-0, and closed the skin wounds with Mersilk 7-0.

#### Lacrimal Sac Injuries

All reconstructions were performed in general anesthesia and the lacerated lacrimal sac was sutured with Vicryl 7-0 or 6-0.

We used bicanalicular stents for intubation and filled the lacrimal sac with viscoelastic. The skin wound was closed with Mersilk 7-0. Dacryocystorhinostomy had to be performed in two patients with severe trauma of the lacrimal sac, and a silicone tube was placed from the conjunctiva directly to the nasal cavity.

#### Nasolacrimal Duct Trauma

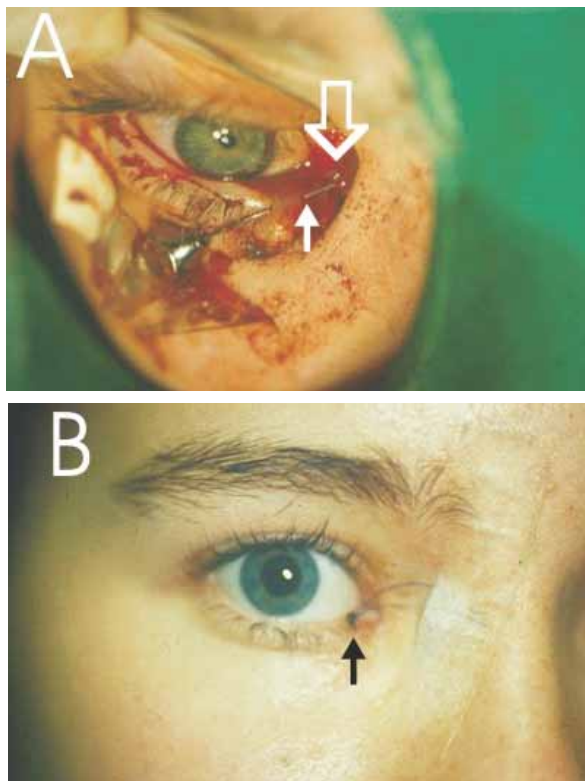
A team approach was required for the reconstruction due to the severity of head trauma in two patients. Otorhinolaryngologists and maxillofacial surgeons performed the reconstruction of the bony parts of the face, which was followed by soft tissue repair, including the lacrimal drainage system, by dacryocystorhinostomy with bicanalicular intubation.

#### Secondary Repair

All operations for secondary repair were performed in general anesthesia. We excised any scars in the canaliculus and identified the anatomical structures by probing and staining with fluorescein dye. The ends of the canaliculus were sutured together with Vicryl 8-0. We intubated the repaired canaliculi in all cases.

### Results

Trauma of the lower canaliculus was the most frequent injury (Fig. 1), occurring in 13 patients. The

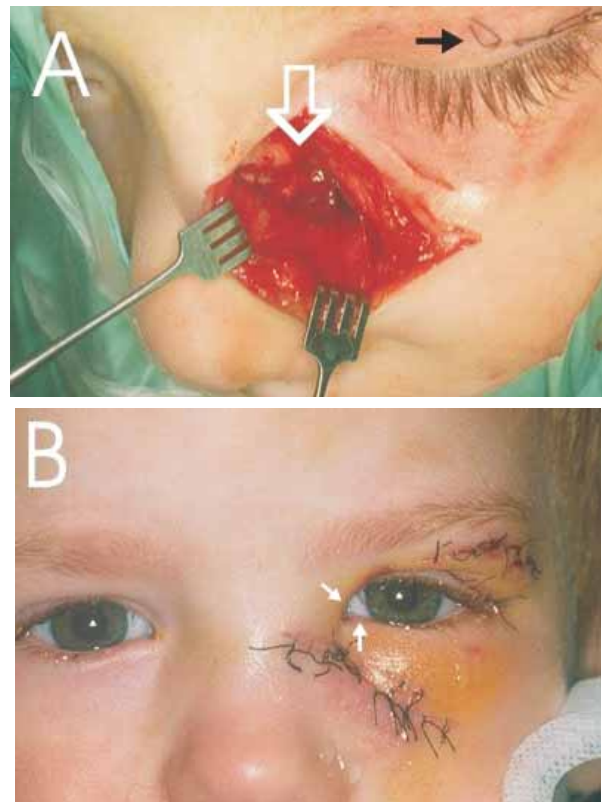


**Figure 1.** A 16-year-old patient with a right lower lid laceration involving the canaliculus, caused by a dog bite. **A.** A probe is inserted through the proximal (open arrow) and distal end of the wound (small arrow) after identification with a fluorescein dye. **B.** The same patient 2 weeks after surgery. The skin sutures were removed one week after surgery. A prolene stent (arrow) is inserted in the lower right canaliculus and taped to the skin.

upper canaliculus was involved in 3 cases, and in 2 cases both canaliculi were lacerated. The causes of trauma were car accidents in 10 cases, dog bites in 5 cases, and accidents at work in 3 cases. We treated five patients with lacrimal sac injuries (Fig. 2). Trauma was caused by a dog bite in three cases and a car accident in two cases. Two patients were treated for nasolacrimal duct trauma associated with severe head trauma after a car accident.

Secondary reconstruction of the lower canaliculi was performed in 7 cases. All patients had tearing after insufficient primary reconstruction. The main cause of insufficient primary reconstruction in all cases was either no intubation or the delay of primary repair (more than 5 days).

A year after surgery, there was a patent lacrimal drainage system and absence of symptoms in all 25 patients after primary repair and in 3 out of 7 patients after secondary repair. Four patients complained of tearing after secondary repair. Irrigation of saline of the lower canaliculi showed the presence of restenosis (Table 1). We observed no complications after primary repair. There were no complaints from the patients due to the silicone stents. Two patients accidentally removed silicone stents before scheduled time. There were no cases of eye irritation, inflammation, granuloma formation or erosion of the canaliculus due to the silicone stents. We did not no-



**Figure 2.** A 6-year-old boy with a complete laceration of the left lacrimal sac and damage to the nasal bone caused by a dog bite. **A.** Laceration of the left lacrimal sac (open arrow), with damage to the nasal bone. Note also a sutured laceration of the right upper lid (black arrow). **B.** The same patient 4 days after surgery. A bicanalicular stent is inserted through both canaliculi (arrows).

**Table 1.** Surgery outcome in 32 patients with lacrimal drainage system trauma treated at the Ljubljana University Eye Clinic, 1999-2003

Type of trauma (No. of patients)	Type of operation	Outcome
Canalicular lacerations: lower canaliculus (n = 13) upper canaliculus (n = 3) both canaliculi (n = 2)	reconstruction of canaliculus with silicone intubation	lacrimal drainage system patent in all cases
Lacrimal sac injury: less severe (n = 3) severe (n = 2)	reconstruction of lacrimal sac with bicanalicular intubation DCR* with conjunctivorhinostomy and intubation with Jones tubes	lacrimal drainage system patent in all cases
Nasolacrimal duct injury (n = 2)	DCR with bicanalicular intubation	lacrimal drainage system patent in all cases
Secondary repair (n = 7)	reconstruction of canaliculus with silicone intubation	lacrimal drainage system patent in 3 cases

\*Dacryocystorhinostomy.

tice any functional or esthetically significant scarring of the eyelids.

### Discussion

Our study showed that early repair of the lacrimal drainage system eliminated complications in comparison with the secondary repair. These results are in accordance with previous studies evaluating success rate after primary and secondary repair of the lacrimal system (4,8). The main reason for a lower success rate after secondary reconstruction is scarring, which makes recognition of anatomical features more difficult.

There is no need for immediate repair of the lacrimal drainage system and a delay of up to 48 h is completely acceptable if an experienced operating team is available. It may even be easier to identify anatomical structures after a short delay due to reduced swelling of the surrounding tissues (6,7).

Controversy exists on whether to repair a single lacerated canaliculus, especially if only the upper canaliculus is injured. A single patent canaliculus provides sufficient tear drainage in more than 75% of the patients, and there is the possibility to harm the uninjured canaliculus by probing it with a pigtail probe in up to 10% of the cases (9,10). In other studies, patients had other complaints besides tearing, like blurry vision and sensation of watering of the eye, which could be caused by single canaliculus occlusion in more than 50% of patients (11). The current concept is to repair any canalicular lesions since we cannot predict which patients will become symptomatic; early repair with modern surgical techniques has a good success rate (6,7,12).

We believe that intubation of the canaliculi is crucial for the prevention of restenosis, and no repair of the lacrimal drainage system should be performed without it. Some studies suggested that intubation alone without microsurgical repair of the canaliculi lead to proper healing of the canaliculi (13).

There is no clear guideline for the timing of the stent removal. In our opinion, the stents should be left in place as long as possible, even up to a year, if the patient is without complaints.

In conclusion, early repair by an experienced team and intubation with silicone stents are crucial in achieving a good success rate after the reconstruction of the lacrimal drainage system. An injury of the lacrimal canaliculus should always be suspected if eyelid

injury is present, as well as an eye, bone, or brain injury in case of an injury to the lacrimal drainage system.

### References

- Rosengren B. On lacrimal drainage. *Ophthalmologica*. 1972;164:409-21.
- Doane MG. Blinking and the mechanics of the lacrimal drainage system. *Ophthalmology*. 1981;88:844-51.
- Herzum H, Holle P, Hintschich C. Eyelid injuries: epidemiological aspects [in German]. *Ophthalmologie*. 2001;98:1079-82.
- Hawes MJ, Segrest DR. Effectiveness of bicanalicular silicone intubation in the repair of canalicular lacerations. *Ophthalm Plast Reconstr Surg*. 1985;1:185-90.
- Wulc AE, Arterberry JF. The pathogenesis of canalicular laceration. *Ophthalmology*. 1991;98:1243-9.
- Hawes MJ, Dortzbach RK. Trauma of the lacrimal drainage system. In: Linberg JV, editor. *Lacrimal surgery*. New York (NY): Churchill Livingstone; 1988. p. 241-62.
- Olver J. *Colour atlas of lacrimal surgery*. 1st ed. Oxford: Butterworth Heinemann; 2001.
- Dortzbach RK, Angrist RA. Silicone intubation for lacerated lacrimal canaliculi. *Ophthalmic Surg*. 1985;16:639-42.
- Jones LT, Wobig JL. *Surgery of the eyelids and lacrimal system*. Birmingham (AL): Aesculapius Publishing Co; 1976.
- Saunders DH, Shannon GM, Flanagan JC. The effectiveness of the pigtail probe method of repairing canalicular lacerations. *Ophthalmic Surg*. 1978;9:33-40.
- Linberg JV, Moore CA. Symptoms of canalicular obstruction. *Ophthalmology*. 1988;95:1077-9.
- Kohlhaas M, Wiegmann L, Gaszczyk M, Walter A, Schaudig U, Richard G. Lacrimal duct treatment with ring intubation in injuries of the upper and lower eyelids [in German]. *Ophthalmologie*. 2001;98:743-6.
- Kersten RC, Kulwin DR. "One-stitch" canalicular repair. A simplified approach for repair of canalicular laceration. *Ophthalmology*. 1996;103:785-9.

Received: December 16, 2003

Accepted: March 15, 2004

### Correspondence to:

Brigita Drnovšek-Olup  
University Eye Clinic  
Ljubljana Medical Center  
Zaloška c. 29/a  
1525 Ljubljana, Slovenia  
brigita.drnovsek@kclj.si