

## Evaluation and Management of Eyelid and Canalicular Injuries

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### Abstract

**Purpose:** To investigate the etiologic factors that cause eyelid, eyelid margin and canalicular injuries and surgical outcomes.

**Materials and methods:** Medical records of 180 patients, who were admitted to the emergency department due to trauma, between 2017 and 2021 years were analyzed retrospectively. The incidence and etiology of the trauma, clinical signs, visual acuity, surgical procedures and possible complications were recorded. Patients with orbital trauma, globe perforation and those with facial injuries were not included in the study. Mean follow-up period was 8 months.

**Results:** 68 men and 12 women, with a mean age of  $29.58 \pm 19.52$  years were included in the study. 45% of the injuries were caused by penetrating trauma between the ages of 26-45, and 55% were caused by blunt trauma, between the ages of 1-15. Of the eyelid traumas 38.8% were work-related, 23.6% were falls, 11.3% were game injuries and 8.8% were home accidents. According to injured site 31.2% had canalicular injury with eyelid margin lacerations, 42.5% had eyelid margin injury, 13.8% had levator aponeurosis injuries, 12.5% had total eyelid avulsion. Canalicular injuries were repaired either by annular intubation with pigtail probe or the monocanalicular intubation. In cases with tissue loss injuries, repair was performed using an advancement flap and free tarsal flap. Postoperative complications were 6.6% traumatic telecanthus, 6.6% traumatic ptosis, and 6.6% canalicular stenosis.

**Conclusion:** The eyelid traumas, mostly treated in the emergency room, needs a well-planned and complex treatment to achieve good cosmetic results and to reduce the possibility of postoperative anatomical and functional disorders.

**Keywords:** Eyelid lacerations; Canalicular lacerations; Trauma; Complications; Reconstruction

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### Introduction

Injury of the eyelid, either penetrating or blunt trauma, is a common medical condition that is often encountered in the emergency department and requires a well-planned and complex treatment to achieve good results and to reduce the possibility of postoperative complications [1].

Eyelid injuries, caused by various mechanisms such as accidents, sports injuries, bites, falls, assault, hitting while running, hooks, sticks, and vary from mild to severe, depending on the depth, location and involvement of the surrounding structures [2]. Some injuries may have tissue loss that disrupts the normal anatomical condition of the eyelid [1,2].

In epidemiological studies involving eyelid traumas, it has been reported that the canalicular system is injured in approximately 16% of cases, and is more common in children and young adults [1-6]. While 72% of canalicular injuries occur in the lower canaliculi, 6-24% of them are bicanalicular system injuries [2,5,7]. Globe perforation may accompany in 20% of lacerations involving the canalicular system [5,8].

In order to prevent dysfunction, the factors leading to periocular injuries must be well questioned and the eyelid anatomy must be well known [9,10]. The optimal time for repair should be within the first 48 hours following injury [2].

In canalicular injuries different surgical techniques, such as annular intubation with pig tail probe, bicanalicular or

monocanalicular intubation can be used in order to ensure the integrity of the anastomosis site and prevent the development of stenosis [2,11]. In eyelid avulsion, the relatively weak posterior limb of the Medial Canthal Tendon (MCT) may be damaged and if not repaired properly, ectropion may developed [7,12]. If there is tissue lost grafting or advancement flaps are used.

In this study, we aimed to investigate the factors that cause eyelid or eyelid margin and canalicular system injures with intact globe and the surgical outcomes.

## Materials and Methods

In this retrospective study medical records of 80 patients who presented to our emergency department complaining about eyelid trauma from January 2017 to March 2021 were reviewed. The study protocol adhered to tenets of Declaration of Helsinki and was approved by the ethics committee. A fully informed written consent form to publish identifiable photograph archival was taken from all patients.

Details about the clinical history, mechanism and the occurrence time of injury, laterality, treatment, and surgical outcomes were analyzed. Ophthalmologic examination showed visual acuity of 20/20 in both eyes, normal ocular movements, mild conjunctival hyperaemia, clear cornea with negative fluorescein stain and normal anterior chamber with no inflammatory reaction. Funduscopy examination, pupil reflexes, and intraocular pressure were all normal.

Depending on the location of eyelid injures, patients were classified into eyelid lacerations with or without involving the eyelid margin, injures involving the medial cathal region and canaliculus, injures related to levator muscle or aponeurosis, and injures those with total eyelid avulsion. Patients with multiple lacerations in the forehead, eyelid injures with globe perforation or eyelid injures together with orbital fractures were not included in this study.

Patients were operated either local or general anaesthesia. The mean time from the first admission to the emergency room to the operation was  $21.75 \pm 15.09$  hours. In cases with canalicular trauma medial lacerated end of the canaliculus was located under an operating microscope and repaired by using either annular intubation with pigtail probe or the monocanalicular intubation with Mini Monoka (FCI Ophthalmics, Marshfield Hill; MA) intracanalicular stents. Bicanalicular stent was used in cases with bicanalicular involvement. The pericanalicular tissue and associated medial cantal tendon injury was repaired with 7-0 polyglactin (Vicryl, Ethicon Inc., USA) interrupted sutures, followed by closure of muscle and skin. Lacerations involving the eyelid margin was repaired by simple closure. In cases where both anterior and posterior lamellae were absent, repair was performed using an advancement flap and free tarsal flap from the ipsilateral eyelid. In patients with levator aponeurosis injury, with orbital fat prolapsus, the prolapsed fat was repositioned and lid crease was performed as in ptosis surgery. The mean follow-up time was  $8 \pm 2.05$  months. Patients were examined at the postoperative 1st day, were reviewed at 1 week, 1 month,

and 3 month respectively. At each follow-up visits, the lacrimal punctum, position of the stent and ocular surface were evaluated. The stent was removed at postoperative 3rd month and the anatomical patency was checked with 27-gauge curved lacrimal irrigation cannula.

## Results

There were 68 (85%) men and 12(15%) women, with a mean age of  $29.58 \pm 19.52$  years (range; 1-78 years). The mean age of men was  $28.72 \pm 18.62$ , and women were  $34.5 \pm 23.41$  years. 80 patients had unilateral lacerations, with equal eyelid involvement. Patients demographics were presented in **Table 1**.

**Table 1:** Demographic characteristics of patients and causes of eyelid trauma.

	Min-Max	Mean $\pm$ SD
Age(year)	28491.00	29.58 $\pm$ 19.52
	n	%
Gender		
Male	68.00	0.85
Female	12.00	0.15
Involvement site		
Unilateral	80.00	1.00
Bilateral	-	-
Laterality		
Right eyelid	40.00	0.50
Left eyelid	40.00	0.50
Type of injury		
Penetrating	36.00	0.45
Blunt	44.00	0.55

36(45%) of the patients had penetrating injures with glass, stone, wire, scissors, hook, piece of iron and wood, dog bite, cat straching, 44 (55%) patients had blunt injures with ball, door handle, hitting, falling, traffic, motor or bicycle accidents.

The classification of eyelid injures according to age groups is shown in **Table 2**. Penetrating injures were mostly seen between the ages of 26-45(25%), while blunt injures were mostly between the ages of 1-15 (18.75%).

**Table 2:** The classification of eyelid injuries according to age groups.

	Ages				
	1-15 years	16-25 years	26-45 years	46-65 years	>66 years
Penetrating	4(5%)	7(8.75%)	20 (25%)	3 (3.75%) 2(2.5%)	
Blunt	15 (18.75%)	3 (3.75%)	17 (21.25%)	7 (8.75%) 2(2.5%)	

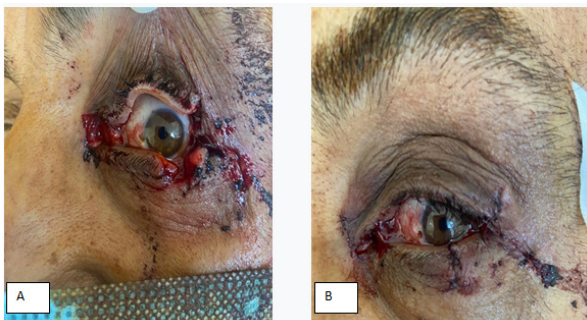
Of the eyelid traumas, 31 (38.8%) were work-related injures, 19(23.6%), were falling, 9(11.3%) were toy injures, 7(8.8%) were homework injures, 5(6.2%) were caused by traffic accidents, 5(6.2%) from fighting, 3(3.8%) from dog bites and 1(1.2%) from

cat scratching (Table 3). Work-related injuries were mostly caused by iron or wood, while home accidents were mostly caused by glass. Stone, ball and stick were responsible factors in game injuries.

**Table 3:** Etiologic factors in eyelid trauma.

	n, %
Work injuries	31 (38.8%)
Fall	19(23.8%)
Toys	9(11.2%)
Homework injuries	7(8.8%)
Traffic/motor accident	5(6.2%)
Fight	5(6.2%)
Dog bite	3(3.8%)
Cat scratching	1(1.2%)

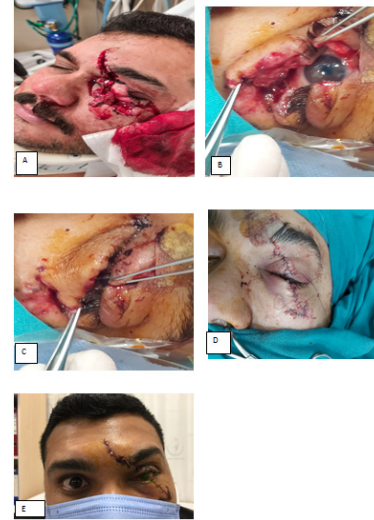
Depending on the location of eyelid injuries, 25 (31.2%) had canalicular injury with eyelid margin lacerations, 34 (42.5%) had eyelid margin injury, 11(13.8%) had levator aponeurosis injuries, 10(12.5%) had total eyelid avulsion (Table 4). Pre and postoperatively eyelid injuries of the patients were shown in Figures 1A and 1B, Figures 2A and 2B and Figures 3A-3E.



**Figure 1:** A- Injury with dog bite (upper and lower lateral margin defect with orbital septum perforation and fat prolapsus, co-existing bicanalicular defect). B-Postoperative view of the same patient with primary closure of the wound, repair of the canaliculus with bicanalicular silicon entubation.



**Figure 2:** A-Canalicular injury with upper and lower eyelid defect due to falling. B-Advancement flap was used in upper nasal defect, and tarsoconjunctival flap of the ipsilateral eyelid was used in the repair of lower defect. Mini Monaco tube was inserted. Transient mechanical ptosis was healed completely.



**Figure 3:** A-Full-thickness laceration of the upper and lower eyelid involving the eyebrow. Tissue loss appears evident on first glance because both the upper and lower lids are suspended on pedicle flaps everted laterally. B, C: Immediate peroperative photograph shows re-approximation of tissue layers by primary closure, D: Peroperative view of the patient at the end of the operation. Avulsed tissues were well re-approximated and sutured with simple closureout, E: Postoperative first day view of the patient showing mild lid edema and mechanical ptosis.

**Table 4:** Classification of eyelid injuries according to site of the injury.

	Laterality	
	Right eye	Left eye
Canalicular injury+eyelid margin	13 (16.2%)	12 (15%)
Inferior	10 (12.5%)	9 (11.25%)
Superior	2 (2.5%)	2 (2.5%)
Bicanalicular	1 (1.25%)	1 (1.25%)
Eyelid margin	1(1.2%)	1(1.2%)
Upper medial eyelid injury	5 (6.25%)	5 (6.25%)
Lower medial eyelid injury	10 (12.5%)	11 (13.75%)
Lower lateral eyelid injury	1 (1.25%)	2 (2.5%)
Levator aponeurosis injuries	1(1.2%)	1(1.2%)
With fat prolapsus	3 (3.75%)	4 (5%)
With canalicular injury	2 (2.5%)	2 (2.5%)
Eyelid avulsion	1(1.2%)	1(1.2%)
With tissue loss	2 (2.5%)	2 (2.5%)
Without tissue loss	4 (5%)	2 (2.5%)

20 (80%) of 25 patients with canalicular injuries were repaired with monocanalicular stent (Mini Monaco), and 5 (20%) were repaired by annular intubation using a pigtail probe.

Other related injuries included lateral cantal tendon injury in 3(3.75%) patients, and orbital septum prolapse in 7(8.8%) patients.

34(42.5%) of eyelid margin defect without tissue loss were repaired with simple closure. Tissue loss in 6 (7.5%) of 10 patients with eyelid avulsion was repaired with grafting and advancement flap.

Postoperative complications were traumatic telecantus in 5(6.6%) patients, traumatic ptosis in 2 (2.5%) patients, ectropion in 1 (1.3%) patient, pyogenic granuloma in 3(3.6%) patient, canalicular stenosis in 5(6.6%) patients. Spontaneous tube prolapse was seen in 3(3.6%) patients. None of our patients developed lid margin notching, lagophthalmos, hypertrophic scar, or infection (**Table 5**).

**Table 5:** Postoperative complications.

	n,%
Telecantus	5 (6.6%)
Traumatic ptosis	2 (2.5%)
Lid retraction	2 (2.5%)
Ectropion	1(1.3%)
Lid margin notching	-
Lagophthalmos	-
Tube related complications	
Pyogenic granuloma	3 (3.6%)
Canalicular stenosis	5 (6.6%)
Spontane prolapsus	3 (3.6%)

## Discussion

Injuries to the periocular region are often complex and involve more than one anatomical structure [13]. With a well-planned approach, it is possible to reduce the possibility of postoperative complications and to achieve good functional and cosmetic results [14]. Firstly a detailed history should be taken to determine the source of injury. Blunt trauma can cause tissue edema. Patients with lid trauma must be examined for both nerve and muscle function [10].

Men are more prone to trauma at a rate of 70-86.5% and mostly occurs between the ages of 5-25 and over the age of 70 [15]. In one study, it was stated that 85% of eye traumas occurred as a result of penetrating injuries, and in another study, this rate was given as 77.7% for blunt trauma and 22.2% for penetrating trauma. It was also stated that 20% of eyelid injuries were work-related, 25.3% were home-garden accidents and 20% were game accidents [4,15-17]. In another study, these rates were reported as 36.6% work-related injuries and 21.1% injuries due to falling [4,15].

In our study, 68(85%) of patients exposed to trauma were men. Penetrating injury due to any of the reasons such as glass, stone, wire, scissors, hook, iron or wood piece, dog bite, cat scratch was present in 45% of the cases and was mostly seen between the

ages of 26-45. Blunt injuries from hitting a ball or door handle, falling while running or walking, or falling out of bed, which is more common in young children, or injuries from traffic, motor or bicycle accidents were mostly between the ages of 1-15.

Of the eyelid traumas, the most common responsible factor in our patients was work-related injuries with a rate of 38.5%. The high rate of work-related injury in men is due to excess number of them were working in the heavy industrial area, and their reluctance to use protective equipment while working. Apart from this, the heavy living conditions make people very aggressive and prone to violence. Eyelid injury as a result of falling was the second most common factor with a rate of 23.8%, and was mostly occurred during play or falling out of bed in children, and in elderly, falling while walking due to systemic diseases such as atherosclerosis, hypertension, and dementia. Home accidents with a rate of 6.2% were mostly occurred in women with glass. 11.3% of our patients were injured with toys, 6.2% injured in traffic accidents and 3.8% were injured by dog bite.

The duration of admission to the emergency service after trauma was reported as 6.8-42.4 hours and the mean time between the arrival to hospital and surgery was reported as 3.5 to 12.9 hours. [15,17] The long duration of this period was attributed to intense periorbital edema, which prevents the operation under elective conditions [15]. In our study, due to the proximity of our hospital to the industrial center and the main road, it was possible for patients to reach the hospital within 1 to 4 hours after injury and to be operated within 24 to 48 hours.

Eyelid traumas may be accompanied by other ocular pathologies such as canalicular injury, eyelid edema, ecchymosis, penetrating eye injuries, lens damage, subconjunctival haemorrhage, and conjunctival laceration, foreign body in the eye, retinal tear, and detachment [15]. When laceration occurs medial to the punctum, all but the most superficial injuries will transect the canaliculus [14]. Canalicular laceration has been reported in all age groups, and reported as 30.2% [15,18,19]. Probing and irrigation of questionable injuries should ideally be done without local anaesthesia because tissue edema may lead to false-positive results [14]. If the eyelid-laceration is repaired without paying attention to the canalicular system, it will result in canalicular occlusion [18]. Different surgical techniques have been described for the treatment of canalicular tears. The use of a pigtail probe has not been a very popular method due to poor surgical results, the risk of trauma to the unaffected canaliculus, and the more challenging technique [18]. Silicone has been the material of choice for stenting, and a good success rate have been reported with Crawford intubation system [18,19]. On the other hand, bicanalicular nasal intubation may require surgical experience and special instruments to retrieve the silicone tubes from nasal cavity [4-5]. This has also been reported to give rise to several complications including punctal or canalicular slitting, granuloma formation, superior loop dislocation, and chronic nasal irritation [5, 20-22].

In our study, 31.2% of the patients had canalicular injuries, of which 23.8% lower, 5% upper, and 2.5% bicanalicular injury. We performed annular intubation with a pigtail probe in our first

cases, but the following years we began to use monocanalicular intubation. Traumatic telecantus and canaliculi stenosis occurred in our first cases that we repaired with pigtail probe. The Mini Monaco tube prevents both the formation of lid contour deformity and the development of stenosis in the canaliculus, and lacrimal irrigation was also positive in this group. As tube-related complications, 3(3.6%) patients had pyogenic granuloma, was simply excised. Follow-up was recommended for epiphora complaints in 5(6.6%) patients whose canaliculi damage was repaired with pigtail probe, but stenosis developed. Lacrimal irrigation was positive in 3(3.6%) patients with spontaneous tube prolapsed in the 1st month postoperatively, and stenosis did not develop.

Traumatic ptosis may occur as a complication due to direct or indirect eyelid trauma, levator disinsertion or third nerve injury [14]. This is a mechanical ptosis caused by hematoma or tissue edema, which usually resolves with time, but secondary stretching or tearing of the levator aponeurosis can cause permanent ptosis [14]. Especially in the pediatric age group, traumatic ptosis should be carefully monitored for the risk of amblyopia [14]. Penetrating injuries may directly damage the levator's nerve supply, and blunt head trauma can result in neurogenic ptosis. Six months should be allowed to pass before undertaking surgery in such instances because spontaneous recovery may occur [14]. It is stated that orbital fat prolapse in horizontal eyelid injuries indicates injury to the levator aponeurosis, and if the prolapsed fat is small it can be repositioned behind the septum, but if it is prolapsed freely, it should be excised in order to reduce the risk of infection because of its insufficient vascularization [14]. In our study, no complication developed after the repair of 7 (8.8%) patients who had horizontal eyelid injury with orbital fat prolapse by preserving the normal anatomy. However, in one of our patients with total eyelid avulsion and fat prolapsus, cicatricial ectropion was developed. We think that it is due to the tension effect while suturing the septum.

In our study we had 4 patients with eyelid defect in the upper medial part of the eyelid and lower nasal tarsal conjunctiva. We used advancement flap and free tarsoconjunctival graft in the closure of the eyelid defect. On the 1st postoperative day, edema, ecchymosis, chemosis and ptosis were present. This mechanical ptosis resolved completely at the 3rd month postoperatively. As care was taken not to create tension in the tissue during the repair of the injured eyelid, a smooth eyelid contour was obtained without any notching, kinking, and trichiasis, and no further reconstruction was required.

It is mentioned that full-thickness lacerations that do not involve the eyelid margin are usually rare, and in the treatment of this type of injuries, the skin is usually closed with or without separate closure of orbicularis muscle. If the tarsal integrity is compromised in injuries involving the eyelid margin, the tarsus should be carefully re-approximated to avoid notching, kinking, and trichiasis [14]. In cases where direct closure is impossible, advancement flaps, such as an aperiostal flap or Tenzel semicircular rotational flaps can be created. However, in elderly

individuals with loose eyelids, even 10% to 15% larger defects can be closed directly [23]. In our study, eyelid injuries in which the canalicular system was intact, the injured parts were closed primarily, or if there was tissue loss, grafting and advancement flaps were used in the treatment. Tissue loss in 3 patients with lateral eyelid tissue loss defect and perforated orbital septum due to dog bite was successfully repaired with advancement flap.

## Conclusion

Eyelid traumas, which are mostly treated in the emergency room, are extremely important due to anatomical and functional disorders such as eyelid deformity, ocular surface disorder, and cosmetic problems. For this reason, it is important to know the factors that cause trauma, to determine the location, size and depth of the injury, and to evaluate whether there is tissue loss. Trauma especially involving the eyelid rim, canalicular system or levator muscle, should be repaired by the ophthalmologist and patients should be well informed about risks and possible sequela.

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