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Comparison of Canalicular Laceration in Pediatric and Adult Patients: Occurrence and Treatment Outcomes

Pediatrik ve Erişkin Hastalarda Kanalikül Kesilerinin Karşılaştırılması: Görülme Sıklığı ve Tedavi Sonuçları

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ABSTRACT

Aim: To evaluate the treatment outcomes of canalicular laceration in pediatric and adult patients, and investigate factors that affect the development of epiphora.
Methods: Data from 90 patients who underwent canalicular laceration repair between April 2014 and February 2022 were analyzed. We included twenty-seven children and sixty-three adult patients with a minimum 6-month follow-up.
Results: The mean age was 7.48±4.5(1-18)years in the pediatric group and 39.81±12.4 (19-65 years). years in the adult group. The mean time between injury and surgery was 1.52±1.67 days in the pediatric group and 2.3±1.4 days in the adult group. The difference was not statistically significant (p>0.05) Mini-Monoka stent was inserted in 24 patients, a bicanalicular silicone tube in 2 patients, and no implant in one patient in the pediatric group. Mini-Monoka stent was inserted in 49 patients, a bicanalicular silicone tube in 9 patients, and no implant in 5 patients in the adult group. Only 1(%3,7) patient had postoperative epiphora in the pediatric group, 8 (%12,6) patients in the adult group. Complaints of epiphora were less frequent in the pediatric group (p:0.05). In both groups, lower canalicular laceration was more common. Outdoor injuries and the need for additional surgery were more frequent in the adult age group.
Conclusion: Based on our study, we found that trauma due to a traffic accident, the presence of an additional injury of the periorbital area, and operation without stent insertion have a significant effect on increasing epiphora. We believe early intervention with a stent-assisted surgery would minimize the problems that may occur in both groups.

Keywords: canalicular laceration, eyelid laceration, Mini Monoka stent, trauma

ÖZ

Amaç: Pediatrik ve erişkin hastalarda görülen kanalikül kesilerinin tedavi sonuçlarını değerlendirmek ve epifora (gözyaşı akıntısı) gelişimini etkileyen faktörleri araştırmak.
Yöntem: Nisan 2014 ile Şubat 2022 tarihleri arasında kanaliküler laserasyon onarımı yapılan 90 hastanın verileri analiz edildi. Altı aydan uzun takip süresi olan 27 çocuk ve 63 erişkin hasta çalışmaya dahil edildi.
Bulgular: Pediatrik grubun yaş ortalaması 7,48±4,5 (1–18 yaş), erişkin grubun yaş ortalaması ise 39,81±12,4 (19–65 yaş) idi. Yaralanma ile cerrahi müdahale arasındaki ortalama süre pediatrik grupta 1,52±1,67 gün, erişkin grupta ise 2,3±1,4 gündü. Bu fark istatistiksel olarak anlamlı değildi (p>0,05). Pediatrik grupta 24 hastaya Mini-Monoka stent, 2 hastaya bikanaliküler silikon tüp yerleştirildi, 1 hastaya ise herhangi bir implant uygulanmadı. Erişkin grupta ise 49 hastaya Mini-Monoka stent, 9 hastaya bikanaliküler silikon tüp yerleştirildi, 5 hastaya ise implant uygulanmadı. Pediatrik grupta yalnızca 1(%3,7) hastada, erişkin grupta ise 8 (%12,6) hastada postoperatif epifora gelişti. Epifora şikayetleri pediatrik grupta daha az sıklıkla görüldü (p:0,05). Her iki grupta da alt kanaliküler laserasyon daha yaygındı. Dış ortam yaralanmaları ve ek cerrahi gereksinimi erişkin hastalarda daha sık gözlendi.
Sonuç: Çalışmamızda trafik kazasına bağlı travmalar, periorbital bölgede ek yaralanmaların varlığı ve stent yerleştirilmeden yapılan operasyonların epifora gelişimini artırdığı saptandı. Her iki hasta grubunda da stent destekli cerrahi ile erken müdahalenin, oluşabilecek komplikasyonları en aza indireceğine inanıyoruz.

Anahtar kelimeler: kanalikül kesisi, göz kapağı kesisi, Mini Monoka stent, travma

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Introduction

Canalicular laceration can occur at any age, but is more common in children and young adults [1]. It has been reported in 16% of all eyelid injuries [2]. To prevent the development of obstruction, surgeons must canalize the canaliculus passage with various stents in traumatic injuries. Researchers have discussed the need for repairing the canaliculus because of the absence of symptoms in some patients who did not undergo surgery or had unsuccessful repair after the canalicular laceration [3, 4]. However, considering the possibility of later damage to the intact canaliculus in the patient's life, it is necessary to repair the canaliculus. This situation is becoming increasingly important, especially for the young population [5]. There is a wide range of techniques described for canalicular repair. The most commonly used techniques are annular intubation of the silicone tube with a round-tipped pigtail probe, bicanalicular silicone tube intubation, and monocanalicular silicone tube intubation [5]. Monocanalicular tube, is easier to use than others, causes less damage to the canalicular system and it’s advantageous because of its short operation time [6].

There are few studies in the literature on lacerations in the pediatric population, and most of them included only a small sample because of the rarity of this injury compared to other ocular injuries. In this study, we aimed to evaluate the results of canalicular incision in patients in pediatric patients and to reveal its differences compared to adults, as well as to investigate the factors that influence epiphora.

Method

This single-centered, cross-sectional study was approved by the local ethics committee of Akdeniz University (Approval Number TBAEK - 565) where the study was conducted, by the ethical standards of the Declaration of Helsinki. Informed consent was obtained from all subjects (or their parents) who met the inclusion criteria and agreed to participate in the study.

Inclusion criteria: Patients under 18 years of age (pediatric group) and between 18-65 years of age (adult group) who underwent canalicular laceration repair surgery at Akdeniz University Faculty of Medicine and were followed up for at least 6 months were included in the study. Exclusion criteria: Patients with punctal stenosis, punctal or eyelid malposition, lid margin disorders, and previous ocular surgery (other than canalicular surgery) were excluded.

Patient demographics, etiology and location of canalicular laceration, surgical procedures, the time between trauma and surgery, the place where the trauma occurred, and the presence of additional injuries were recorded (Table 1). The mechanism of canalicular laceration was classified as direct (penetrating injury with a sharp object) or indirect (avulsion of the canaliculus secondary to blunt force) [7]. Follow-up data were collected to assess success, defined as the absence of symptomatic epiphora and negative dye disappearance test at the last follow-up.

Evaluation of Epiphora

Functional success was defined as the absence of epiphora [8,9]. Fluorescein Dye Disappearance Test and MUNK score were used to assess epiphora. Since irrigation is not possible in all patients in the pediatric age group, the anatomical success was not compared [10].

Fluorescein Dye Disappearance Test (FDDT): After a drop of 2% fluorescein was placed in the fornix, the fluorescein remaining in the conjunctival sac was examined with cobalt blue light after five minutes. The amount of fluorescein remaining was graded on a scale of 0 to 4, with 0 indicating no dye remaining and 4 indicating all dye remaining. Retention of fluorescein indicated a delay in tear flow. Values 0 and 1 were considered negative FDDT, and values 2 to 4 were considered positive FDDT. [11].

Epiphora was also assessed subjectively with the Munk scale [12]. All patients were asked to subjectively rate the severity of their epiphora using the 0–4 scale from 0 (no watering) to 4 (constant watering) developed by Munk et al. [12]. Grades 0 and 1 were considered negative Munk, and grades 2 to 4 were positive Munk [11].

Surgical technique

All surgeries were performed under general

anesthesia using a surgical microscope to locate the medial cut end of the canaliculus by a single experienced surgeon (HDI). A Bowman 0–00 lacrimal probe was used to navigate the canaliculus until both lacerated ends of the canaliculus were localized. In some cases, the medial cut end of the canaliculus was also identified by direct inspection of the pale-appearing mucosa of the canalicular lumen or by injection of the opposite punctum with fluorescein.

Depending on the type of lesion and surgeon preference, bicanalicular stents such as the Crawford (FCI Ophthalmics, Marshfield Hills, MA) or monocanalicular stents such as the Mini Monoka (FCI Ophthalmics, Marshfield Hills, MA) were used. A pigtail probe was used for intubation with a bicanalicular silicone tube when the deep end of the laceration was difficult to identify. Stents were inserted into the dilated punctum and advanced until they exited the canaliculus at the level of the laceration. Then the lacerated ends of the canaliculus were sutured with 7.0 polyglactin (Vicryl, Ethicon Inc., USA). The overlying skin and the lid margin were sutured with non-absorbable suture material 6.0 polypropylene (Prolene, Ethicon Inc., USA). Postoperatively, a topical steroid and antibiotic drops were prescribed for one or two weeks, and the stent was left in place for 2 to 3 months. Patients were followed up at one week, one month, three months, six months, and one year after surgery.

In some patients, stent insertion cannot be performed due to a lack of anatomical suitability or narrowing of the canaliculus due to late admission. This might be due to late recognition of the canalicular laceration or inability to operate early due to additional health problems (hospitalization in the intensive care unit).

Statistical analysis

The statistical analysis was carried out using IBM SPSS version 23.0 software (SPSS Inc., IL-USA). To define the sample, continuous variables were expressed as mean ± standard deviation and median (minimum-maximum), and categorical variables as numbers and percentages. The normality assumption for the independent variables was tested with the Shapiro-Wilk and Kolmogorov-Smirnov tests. When comparing the continuous data, the Mann-Whitney U test was applied to the non-normally distributed data, and the t-test for independent samples was used for the normally distributed data. The categorical results were analyzed using the chi-square test and Fisher's exact test. The results were analyzed with a 95% confidence interval, and a p-value of < 0.05 was considered statistically significant.

Results

Data from 90 patients who underwent canalicular laceration repair between April 2014 and February 2022 were analyzed. In the pediatric group, 20 patients were male and 7 patients were female. In the adult group, 49 patients are male and 14 patients are female. The number of male patients was statistically significantly higher in both groups ($p<0.001$).

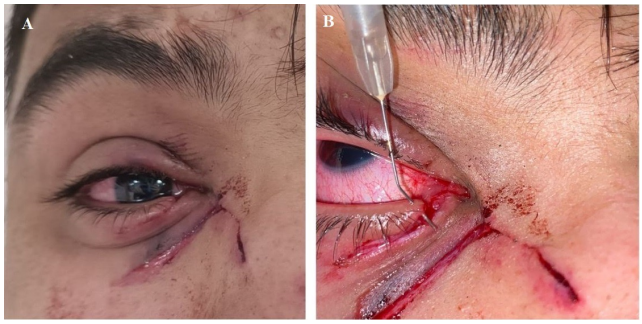


Figure 1. The photograph shows a 15-year-old male patient with a canalicular laceration caused by a shock absorber spring. A: The canalicular laceration accompanied by a periorbital skin incision. B: Lacrimal cannula showing the cut end of the canaliculus

The mean age in the adult group was 39.81±12.4 years (19-65 years). 15 patients had injuries that required additional surgical intervention (9 corneal scleral penetration surgery, 3 pars plana vitrectomy, 3 conjunctival laceration suturation). 8 patients had epiphora complaints after surgery. (Table 1)

The right canalicular laceration and inferior canalicular laceration were more common in both groups. The need for additional surgery was higher in the adult group than in the pediatric group, but the difference was not statistically significant (p: 0.133) (Table 1). When we compared the groups, there was a significant difference only between the location of the accident and the presence of epiphora ($p<0.001$; p: 0.005 respectively) (Table 2).

Right/left canaliculus, lower/upper/both canaliculi, blunt/penetrating trauma, pigtail use had no effect on epiphora, while patients without any stent implantation complained of epiphora significantly more than patients with Mini Monoka and bicanalicular stent implantation. (p: 0.289; p: 0.097; p: 0.158; p: 0.343 and p<0.001, respectively).

Table 1: Demographic data of patients with canalicular laceration repair.

	Pediatric Group (n:27)	Adult Group (n: 63)	Total	p value
Canaliculus				
Right	18 (66.7%)	35 (55.6%)	53 (58.9%)	0.359
Left	9 (33.3%)	28 (44.4%)	37 (41.1%)	
Canaliculus				
Upper	4 (14.8%)	18 (28.6%)	22 (24.4)	0.290
Lower	20 (16.8%)	26 (57.1%)	56(62.2%)	
Both	3 (11.1%)	9 (14.3%)	12 (12%)	
Stent				
Mini Monoka	24 (88.9%)	49 (77.8%)	73 (81.1%)	0.466
Bicanaliculer Silicone	2 (7.4%)	9 (14.3%)	11 (12.2%)	
No	1 (3.7%)	5 (7.9%)	6 (6.7%)	
Accident Place				
Home	20 (74.1%)	13 (20.6%)	33 (36.7%)	<0.001
Outside	6 (22.2%)	19 (30.2%)	25 (27.8%)	
Assault	0	8 (12.7%)	8 (8.9%)	
Traffic Accident	1 (3.7%)	23 (36.5%)	24 (26.7%)	
Type of Trauma				
Direct (Penetrating)	15 (55.6%)	29 (46%)	44 (48.9%)	0.408
Indirect (Blunt)	12 (44.4%)	34 (54%)	46 (51.1%)	
Additional Surgery				
Yes	2 (7.4%)	14 (22.2%)	16 (17.8%)	0.133
No	25 (92.6%)	49 (77.8%)	74 (82.2 %)	
Pigtail Usage				
Yes	3 (11.1%)	9 (14.3%)	12 (13.3%)	0.685
No	24 (88.9%)	54 (85.6%)	78 (86.7 %)	
Epiphora				
Yes	1 (3.7%)	8 (12.69%)	9 (10%)	0.05
No	26 (96.3%)	55 (87.3 %)	81 (90%)	

In patients with canalicular laceration due to a traffic accident, epiphora was statistically significantly higher than in other groups (p: 0.014). Epiphora was more frequent in patients with additional injuries than in patients without (p: 0.049). Epiphora was less frequently observed in the pediatric group (p: 0.05).

Table 2: Evaluation of the relationship between epiphora and patient data

	Epiphora		p value
	Yes	No	
Canaliculus			
Right	7 (13.2%)	46(86.8%)	0.298
Left	2 (5.4%)	35 (94.6%)	
Canaliculus			
Upper	3 (13.6%)	19 (86.4%)	0.097
Lower	3 (5.4%)	53 (94.6)	
Both	3 (25%)	9 (75%)	
Stent			
Mini Monoka	3 (4.1%)	70 (85.9%)	<0.001
Bicanaliculer Silicone	3 (27.3%)	8 (72.7%)	
No	3 (50%)	3 (50%)	
Accident Place			
Home	0	33 (%100)	0.014
Outside	3 (12%)	22 (88%)	
Assault	0	8 (100%)	
Traffic Accident	6 (25%)	18 (75%)	
Type of Trauma			
Direct (Penetrating)	7 (15.2%)	39 (84.8%)	0.158
Indirect (Blunt)	2 (4.5%)	42 (95.5%)	
Additional Surgery			
Yes	4 (25%)	12 (75%)	0.049
No	5 (6.8%)	69 (93.2%)	
Pigtail Usage			
Yes	2 (16.7%)	10 (83.3%)	0.343
No	7 (9%)	71(91%)	

Discussion

In our study, male patients and inferior canalicular lacerations were more common in both pediatric and adult groups. Outdoor injuries and the need for additional surgery were more common in the adult group. Postoperative epiphora complaint was less in the pediatric group. There was no difference in the success rate between monocanalicular or bicanalicular stenting. After canalicular repair, functional success was achieved in 96.3% of patients in the pediatric group and in 87.3% of patients in the adult age group.

There are many reasons for canalicular lacerations. Although they vary from society to society in the literature, the most common causes cited are violence/fighting, dog bites or scratches,

falls, and injuries with a metal rod or wooden stick [10, 13]. In our study, the most common cause in the pediatric age group was fall (6 patients) and in the adult patients, it was a traffic accident (23 patients). In another study investigating pediatric canalicular lacerations, the most common cause of canalicular lacerations was a metal coat hanger [10]. In this context, the different uses of hangers due to the different clothing worn and the impact of cultural differences are mentioned [10].

In previous studies, canalicular lacerations were grouped into two: direct (penetrating) trauma and indirect (blunt) trauma according to their mode of occurrence [14]. When we grouped based on these studies, 44 patients (48.9%) in our study had direct trauma, and 46 (51.1%) patients had indirect trauma. We found no statistically significant difference between the pediatric and adult groups. Jordan et al. reported in their study that 54.2 of patients had direct trauma and 45.7% had indirect trauma [15]. The results of our study were similar to those reported in the literature.

In our study, functional success in the pediatric age group was 96.3%. The functional success was reported as 87.5% and 94.4% in the previous studies examining pediatric canalicular laceration [10, 16]. Our results were consistent with the literature.

Previous studies have shown that the lower canaliculus has a much higher risk of injury than the upper canaliculus [17, 18]. In our study,similarly, lower canalicular laceration was more common in both the pediatric and adult age groups. The choice between monocanalicular or bicanalicular stenting often depends on whether the damage affects one or both canaliculi or on surgeon preference, previous studies have found no difference in outcomes between them [10, 19]. In our study, similarly, there was no difference between the two types of stents. However epiphora occurred in half of the patients in the group in which no stent was inserted. Stent insertion can not be performed in these patients due to a lack of anatomical suitability or narrowing of the canaliculus due to late admission in our study. Therefore, we recommend surgical intervention for all patients presenting with canalicular laceration, especially in the young population, as the unaffected canaliculus may become blocked in subsequent years due to trauma or disease.

Another controversial issue regarding the canalicular laceration is the timing of the procedure. [20]. In a previous study, it was reported that there was no statistical difference in terms of canal patency between patients operated on within 7-48 hours of injury and those operated on within the first 6 hours, showing that the operation time can be prolonged [20]. However, canalicular laceration should be operated on within 24-72 hours of injury [20]. This view is often held as it becomes difficult to recognize the medial part of the laceration due to the developing fibrin and granulation tissue [20]. In a study of pediatric canalicular laceration, surgery was performed in the first 48 hours in 81.4% of patients [10]. In our study, 81 patients (90 %) were operated on within the first 36 hours.

Another point of interest in canalicular laceration repair studies is premature stent loss [21, 22] They reported that children may experience premature stent loss more frequently than adults because of eye rubbing and scratching [5, 23]. In our study, we didn't experience premature stent loss in both groups. In another study, they compared Mini Monoka and Masterka monocanalicular stents (FCI-Ophthalmics, Marshfield Hills, MA) in pediatric patients and observed that there was less stent loss in Masterka [23]. Based on previous studies, it might be important to closely monitor children for stent loss.

There might be several reasons why epiphora is more common in the adult group in our study. The higher number of lacerations after traffic accidents compared to the pediatric group and the higher likelihood of additional injuries would lead to more disruption in tissue integrity. Therefore, canaliculus anatomy may also be affected by periorbital fractures and tissue loss, which increases the incidence of epiphora. In addition, it is more difficult to question epiphora in the pediatric age group.

Limitations

This study has some limitations. One limitation is its retrospective and single-centre design. Another is that the number of patients in the two groups was not equal, as canalicular laceration

was found to be less likely to occur in pediatric patients than in adults. A further limitation is the difficulty in identifying an objective method to assess anatomic patency in the pediatric age group, which may have led to an overestimation of the success rate and possible recall or reporting bias in pediatric patients due to the difficulty in assessing subjective epiphora. To our knowledge, this is the first study to compare the outcomes of canalicular laceration in children and adults.

Conclusion

In this study we found that the presence of additional injury and injury due to traffic accidents increased the frequency of epiphora. The type of stent does not appear to have an impact on the outcome of the surgery. We believe that the insertion of stents and early intervention would minimize the problems that may occur, especially in pediatric patients.

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