Management outcomes of canalicular laceration in children

Fatimah Alhammad[1,2], Alicia Galindo-Ferreiro[3], Rajiv Khandekar[1], Osama Al-Sheikh[1], Fatimah Alzaher[2], Silvana Schellini[1,4]

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Abstract:

PURPOSE: To report the epidemiological data, clinical profile, management, and outcomes of canalicular lacerations in the pediatric age group in a tertiary eye care hospital in Saudi Arabia.

METHODS: This retrospective study evaluated pediatric patients who underwent canalicular laceration repair in the last 15 years at King Khalid Eye Specialist Hospital (KKESH), Saudi Arabia. Demographics, causes of injury, type of trauma, surgical approach, and outcomes were analyzed. The success of repair was defined as the absence of epiphora after canaliculus repair with negative dye disappearance test (DDT). Success within subgroups was compared. $P < 0.05$ was considered statistically significant.

RESULTS: The study sample was comprised of 43 patients, with a median age of 6.35 years (range, 1.77–17.96 years). Most of the patients were males (69.8%). Sharp objects were the most common cause of canalicular laceration (46.5%), being 9 (20.9 %) caused by a metallic clothing hanger. Lower canaliculus was involved in 65.1%, upper canaliculus in 32.6%, and both canaliculi in 2.3% of patients. Canaliculus repair was performed with a bicanalicular stent in 58.1 % and monocanalicular stent in 41.9 % of patients.The success rate and risk of complications using bicanalicular or monocanalicular stent did not differ ($P = 0.065$). Functional success was achieved in 87.5% of patients.

CONCLUSION: Canalicular laceration is common in male children, mainly affecting the lower canaliculus. There was no difference in success rate between monocanalicular and bicanalicular stent. As canalicular laceration could be related to social determinants, the main causes should be highlighted in community health education initiatives.

Keywords:

Canalicular, eyelid, laceration, trauma

Introduction

The canalicular system is vulnerable to injury because of its superficial location within the eyelid. The leading cause and mechanisms of injury vary according to populations.[1] These injuries without appropriate management can lead to scarring, stenosis, and inflammation, which may cause permanent epiphora.[2] Therefore, early and accurate diagnosis and appropriate surgical management are imperative for optimal outcomes.

There is paucity in the literature of canalicular laceration studies in the pediatric population, and most of them included a small sample size due to the rarity of this injury compared to other ocular injuries.[3,4]

This study aimed to evaluate and add further evidence on the demographic and clinical characteristics of pediatric patients with canalicular injuries and the outcomes of different surgical approaches in the largest specialized eye hospital in Saudi Arabia.

Methods

Study design

A retrospective review was performed on pediatric patients (younger than 18 years of age), who underwent surgical repair after canalicular laceration in the last 15 years at King Khaled Eye Specialist Hospital, Saudi Arabia. Patients who had previous surgery to the lacrimal system were excluded as well as patients who underwent canalicular repair at another hospital. The local ethics

[1]Oculoplastics and Orbit Division, King Khaled Eye Specialist Hospital, Riyadh, [2]Oculoplastics and Orbit Department, Dhahran Eye Specialist Hospital, Dhahran, Saudi Arabia, [3]Department of Ophthalmology, Rio Hortega University Hospital, Valladolid, Spain, [4]Department of Ophthalmology Faculdade de Medicina de Botucatu – UNESP, São Paulo, Brazil

Address for correspondence: Fatimah Alhammad, King Khalid Eye Specialist Hospital, P.O. Box: 7191, Riyadh 11462, Saudi Arabia. E-mail: dr.alhammad@ymail.com

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committee approved this study, and patient consent was waived due to the retrospective nature of the study. Data were collected on patient demographics and clinical profile including age, gender, side of the lacrimal system affected, mechanism and cause of injury, other associated trauma to the eye or periocular area, the time between the trauma and the canalicular repair (in days) and signs of infection at presentation. Data were also collected on the details of intraoperative procedures including the technique to locate the medial cut end of the severed canaliculus, type of stent, suturing technique, suture material, the experience of the surgeon (oculoplastic consultant or oculoplastic fellow) and intraoperative complications. Follow up data were collected to assess the success which defined as a lack of symptomatic epiphora, and negative dye disappearance test in the last follow up visit. Anatomical confirmation of procedure success by the absence of a soft stop and patency of lacrimal system with saline irrigation during follow up visits were waived in most of the patients because of difficulty of doing these examinations in the clinic for the children. Additionally, data were collected at the time of stent removal, time of last follow up, and patient condition at last visit.

Surgical technique

All surgeries were performed under general anesthesia using an operating microscope to localize the medial cut end of the canaliculus. A Bowman 0–00 lacrimal probe was used to navigate the canaliculus until both lacerated ends of canaliculus were located. The medial cut end of canaliculus was also identified by direct inspection of the pale appearing mucosa of the canalicular lumen in some cases or by injecting the opposite punctum with fluorescein. A pigtail probe was used in cases in which previous methods were failed. Bicanalicular stents such as Crawford™ (FCI Ophthalmics, Marshfield Hills, MA), Bika bicanalicular™ (FCI Ophthalmics, Marshfield Hills, MA), Visitec™ Lacrimal Intubation Set (Beaver-Visitec International, Abingdon, UK) or monocanalicular stents as Mini-Monoka™ (FCI Ophthalmics, Marshfield Hills, MA) or MasterK™ (FCI Ophthalmics, Marshfield Hills, MA) were inserted based on the type of lesion and surgeon preference.

Monocanalicular stents were chosen according to the surgeon preference in cases with only one affected canaliculus and were inserted into the dilated punctum and advanced until it exited the canaliculus at the level of the laceration. With two non-toothed forceps and a hand-over-hand technique, the stent was passed through the medial cut end. Then, the tube was adjusted until the head of the stent reached the punctum. When using bicanalicular stents, the silicone tubing was inserted passing the probe through the punctum and identifying the medial cut end of the lacerated canaliculus, through the lacrimal sac and down to the nasolacrimal duct reaching the nasal fossa and retrieving the stent from the nostril with a Crawford hook. Then, the stent was passed through the opposite canaliculus to the lacrimal sac reaching the nostril, and both sides were knotted. Then the lacerated ends of the canaliculus were sutured using 7–0 polyglactin (Vicryl®, Ethicon, Inc) with one of two techniques: direct canalicular wall sutures (DC) or pericanalicular sutures (PC). In the DC group, the suturing was performed with the silicone stent retracted to expose the canalicular wall. Then two interrupted horizontal mattress absorbable sutures were passed through the canalicular walls and submucosa, and knots were maintained outside the lumen. In the PC group, two horizontal mattress absorbable sutures were placed in the surrounding submucosa at 120° around the lacerated area. Next, the overlying skin and lid margin, if applicable, were sutured with non-absorbable or absorbable sutures (Coated Vicryl® polyglactin; Silk Suture©; or Chromic gut©, Ethicon, Inc). Postoperatively, a topical steroid and antibiotics drops were prescribed for one or two weeks, and the stent was left in place for 2 to 3 months. Patients were followed up after one week, one month, three months, and six months after surgery.

Analysis of data: data was collected using a pretested data collection form and transferred to an Excel® spreadsheet (Microsoft Corp., Redmond, WA, USA). Statistical analysis was performed with Statistical Package for Social Studies (SPSS 23; IBM Corp., New York, USA). For quantitative variables with a normal distribution, the mean and standard deviation were calculated. If the distribution was not normal, the median, 25% quartile, minimum and maximum values were calculated. For qualitative variables, we calculated frequencies and percentage proportions. To compare the success in subgroups, we used two-tailed test. *P* values of less than 0.05 indicated statistical significance.

Results

The study population was comprised of 43 patients with canalicular laceration who underwent surgical repair. The patient demographics and clinical profile at presentation are reported in Table 1.

Most of the patients had no associated injuries other than laceration of another aspect of the eyelids (44.2%). Two patients (4.7 %) had associated open globe injury. Sharp objects were the most common cause of canaliculus laceration (46.5%), the majority of which caused by a metallic clothing hanger (20.9 %, 9 patients).

The interval from injury to surgical repair was 24 hour or less in 72.1% of patients, within 48 h for 81.4%, after 48 h for only eight patients (18.6 %) referred from outside the city.

All the patients underwent surgical repair under general anesthesia, and the procedure was performed in the main surgical room using a surgical microscope. The medial cut end of canaliculus was successfully detected under a microscopic view, or by using probing and irrigation. Re-anastomosis of canalicular ends was performed in the majority >90% using a silicone tube and pericnalicualr sutures rather than direct suturing of canalicular walls. Bicanalicular stents were used in 58.1% while monocanalicular stent was used in only 41.9

Table 1: Demographics and clinical profile of patients with canalicular laceration

Age (years)	Median		6.35
	25% quartile		4.32
	Minimum		1.71
	Maximum		17.96
		Number of patients	**Percent of patients**
Gender	Male	30	69.8
	Female	13	30.2
Canaliculus	Upper	14	32.6
	Lower	28	65.1
	Combined	1	2.3
Side affected	Right lid	17	39.5
	Left lid	26	60.5
Object of injury	Sharp objects	20	46.5
	Blunt trauma	13	30.2
	Road traffic accident	2	4.7
	Not specified metallic object	6	18.6
Interval between injury and repair (days)	within 48 h	35	81.4
	After 48 h	8	18.6

%. The success rate using bicanalicular or monocanalicular stent did not differ ($P = 0.065$).

Most of the patients had no intraoperative complications (93 %). However, three patients had punctum cut during the procedure. We observed postoperatively development of a functioning fistula beside the punctum, which gave an appearance of double puncta in five patients (16.3%) had a bicanalicular stent and in two patients had a monocanalicular stent [Table 2].

The median duration of the follow up was 30.5 months, range (3–161 months) but 6 patients operated and had follow up in their referred center. The median interval between surgery and stent removal was 4 months.

Functional success was achieved in 35 patients (87.5%); they were asymptomatic with negative DDT. One patient was asymptomatic although had delayed DDT. Because the majority of our patients were young children, irrigation was done on last follow up for only 7 patients (16.3%) and was patent, so anatomical success was not calculated.

The evaluation of independent variables related to success rates after treatment showed significance only when the injury affected the upper canaliculus ($P = 0.011$). None of the other variables were significantly associated to the success rate including age ($P = 0.244$), gender ($P = 0.469$), the type of stent used ($P = 0.065$), suturing technique *(*$P = 0.662$), level of the surgeon ($P = 0.123$) and the duration between injury and repair ($P = 0.257$). Since none of the independent variables were significantly associated with the success of canalicular repair, regression analysis cannot be carried out.

Discussion

Our demographic data indicated that children who underwent canalicular repair were mainly males in early childhood with a median of 6 years of age. This observation was compatible with previous studies that reported boys to have a higher risk of canalicular injuries compared to girls.[5-8] There were a higher number of cases with lower canaliculus injury (65.1%) likely due to the greater exposure compared to the superior canaliculus.

Although rarely reported in the medical literature as a cause of ocular and head and neck injury[9], we found that the most common cause of canaliculus laceration was metallic clothing hanger. This design of a clothing hanger is frequently used, compared to plastic and wooden clothing hangers, in our population and in most of the laundries, especially those for cleaning the traditional Saudi thobe. According to many previous reports, a dog bite was the most common cause of canalicular injury in children.[10] However, dogs are not familiar pets in Saudi culture, explaining the difference between our study and others. In India, injury due to the "blouse-hook fastener" was unique to infants.[5] Taken together, the Indian study and our observation indicate that the cause of canalicular laceration is usually related to social determinants, which should be highlighted in community health education programs.

Most of our patients 72.1 % were operated within one day of the injury and this consistent with the optimal time for surgery which is between 24–72 hours aiming to be in the window between regress of acute edema for better anatomical visualization and before scarring process.[8]

All of the patients underwent surgical repair under general anesthesia in the main operating room without infiltrating of local anesthesia. A previous study reported a success rate of 85.9% among patients who underwent surgery under general anesthesia in an operating room compared to 36.8% success among patients who underwent surgery in the minor procedure room[3] probably because excessive infiltration of local anesthesia makes it more difficult to identify the structures.

Table 2: Intraoperative details and postoperative complications of patients with canalicular laceration

		Number of patients	Percent of patients
Technique used to locate proximal end of canaliculus	Only microscopic visualization	12	27.9
	With Probing	20	46.5
	With Irrigation	8	18.6
	With Pigtail	3	7
Suturing technique	Direct suturing	4	9.3
	Pericanalicualr suturing	39	90.7
Stent used	Bicanalicular	25	58.1
	Monocanalicular	18	41.9
Intraoperative Complications	None	40	93
	Punctum laceration	3	7
Surgeon	Oculoplastic consultant	29	67.4
	Oculoplastic fellow	14	32.6
Postoperative Complications	Non	26	60.5
	Double puncta	7	16.3
	Long slit punctum	1	2.3
	Punctal stenosis	2	4.7
	Stent prolapses	5	11.6
	Loss of stent	1	2.3
	Notch involving canaliculus	1	2.3

A careful examination under magnification by using a Bowman probe, as performed in the current study, can likely identify the majority of the damaged canalicular anatomy. However, this step of canalicular repair might carry difficulty of identification of the medial cut end of a severed canaliculus, especially when the laceration is along the wall of canaliculus or near the common canaliculus with severe edema.[11] Other techniques have been used for this step including irrigation with air, water, fluorescein or viscoelastic agents.[4]

The choice between bicanalicular or monocanalicular stent is often determined by whether the damage involves one or both canaliculi or surgeon preference. If only one canaliculus is involved and the lesion is near the punctum, a monocanalicular stent is advocated to avoid potential damage to the healthy fellow canaliculus.[2,5,8] However, our study concurs others reported no difference in success rates with mono- or bi-canalicular stents for monocanalicular injury.[12]

Our approach for anastomosis of severed canalicular ends was mainly by PC sutures because we considered PC sutures in addition to intubation are sufficient for canalicular re-anastomosis. However, the effectiveness of PC sutures remains controversial. A survey in the United Kingdom revealed that only 7% of ophthalmologists do not suture the canalicular wall.[13] A study with short follow up reported higher success rates with DC repair compared with PC sutures[14], but a DC suture of the delicate canaliculus tissue may potentially cause further damage due to extra manipulation or suture reaction.[15,16] According to our results, the PC or DC surgical approach did not have a significant influence on the postoperative patency of the canaliculus, but this outcome should be interpreted with caution due to the small number of cases in the DC suture group.

In our study, the time to stent removal was in a median of 4 months after insertion. There is no consensus regarding the best time for stent removal, and there is evidence suggesting that stent should remain in place long enough for adequate mucosal healing, minimizing the risk of ductal stenosis.[13] The ideal stenting period was suggested to be at least three months, according to an experimental animal study[17] and several clinical studies.[16,18-20] Some surgeons advocate the removal of a monocanalicular stent approximately six weeks postoperatively, while bicanalicular stents are often left in place for up to 3 months.[7]

We observed a low complication rate, with 93% of cases having no complication during surgery and only 3 (7%) of patients had punctal laceration during stent placement. Generally, the silicone tube is well tolerated.[19] The most frequent postoperative complication in our study was the development of a canalicular fistula beside the punctum, which gave the appearance of double puncta in 7 (16.3 %) of the patients. Previous studies have reported the appearance of double puncta in 12.3% to 9.25% of cases.[21]

In many previous studies, functional success was determined by the absence of epiphora, and anatomical success rate by irrigation of the lacrimal system.[6,21] In our study, syringing to confirm patency of the repaired canaliculus was performed in only 7 patients because the majority of the patients were young children. Hence anatomical success cannot be accurately estimated in our patients.

We observed functional success was achieved in 87.5% of the patients, similar to what was reported in the previous study[3,22] However, the absence of epiphora does not necessarily indicate successful repair, because a single functioning canaliculus is usually sufficient to drain basal tear secretion.[14,23] Ortiz *et al*. noted an absence of tearing in 75% of patients with proven anatomical obstruction.[23]

According to our study, there was no association between success rate and age, gender, type of trauma, the lag between

trauma and the canalicular laceration repair, the type of stent used, suturing technique and level of the surgeon. Wu *et al.,* had a similar observation about these factors except for the level of the surgeon, which found to be significantly affecting the success of repair.[20] In our study, senior oculoplastic surgeons performed more than two-thirds of the surgeries, and the success rates did not differ significantly based on the surgeon experience. Another study reported the success rate varied significantly with the level of surgeon training, with the highest success rate (84.0%) reported for senior oculoplastic surgeons.[12] But others reported a success rate of 13% among senior surgeons.[8] Given the contradictory outcomes, variation in success rate by the experience of the operating surgeon might requires further investigation.

The only significant association found in this study was the higher success rate when the upper canaliculus was affected; this could be because the presence of functioning lower canaliculus makes the symptoms less. Although most recent studies[24,25] indicated that the rate of tear flow through either upper or lower canaliculus is similar, some reported that more outflow occurs through the lower canaliculus.[26-28] However, a study observed that lower canalicular involvement, present a unique problem in maintaining good wound closure because of the horizontal tension of the orbicularis muscles on the lacerated portion of the canaliculus and because of gravity, this could explain our results.[20]

There are some limitations to our study, including the retrospective design and the difficulty of an objective method for evaluating anatomical patency in the pediatric age group, which could have overestimated the success rate. However, this study included larger sample size compared to similar studies.

Conclusion

In conclusion, our study indicates that male children were more likely to have a traumatic injury to the canaliculus, mainly affecting the lower canaliculus. Microsurgery, with silicone stent intubation, is related to good outcomes in the vast majority of patients. The type stent used for canalicular repair does not seem to influence the outcome of canaliculus repair. As canalicular laceration could be related to social determinants, the main causes should be highlighted in community health education initiatives.

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Conflicts of interest

There are no conflicts of interest.

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