

Clinical results of primary repair with silicone tube intubation after traumatic injury of lacrimal canalicular system

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Abstract

Aim: To evaluate clinical results of primary repair with silicone tube intubation after traumatic injury of lacrimal canalicular system.

Materials and Methods: Fifteen patients applied to ophthalmology clinic at Afyonkarahisar Health Sciences University between January 2010 and May 2020 with traumatic injury of lacrimal canaliculi were included in the study. Data including the patients' demographic characteristics, causes of injury, time between trauma and surgery, surgical technique, post-operative time of silicone tube removal, post-operative follow-up period, and anatomical as well as functional outcomes were retrieved from the patients' clinical records.

Results: Mean age of the patients was 26±22.5 (3 to 70 years) years (13 males, 2 females). Ten patients (66.6%) had blunt trauma, whereas penetrating injury was detected as causative factor of trauma in five patients (33.3%). Twelve patients (80%) had isolated lower canalicular injury, two (13.3%) had upper canalicular injury, and the remaining one (6.7%) had both lower and upper canalicular injury. The primary surgical repair with silicone tube intubation was performed in all patients. Twelve patients (80%) had successful anatomical and functional outcomes. Post-operative ptosis was detected in one patient. Although two patients (13.3%) underwent re-operation at another center, status their functional success could not be acquired.

Conclusion: Annular intubation with the silicon tube can be used as an effective method for providing anatomical and functional integrity of the drainage system after blunt and / or penetrating traumatic injuries of the lacrimal canaliculi.

Keywords: Pigtail probe; silicone tube; traumatic canalicular injury

INTRODUCTION

Injuries to the canalicular portion of the lacrimal drainage system may occur during facial trauma, especially following traumatic injury of orbit and / or its surroundings. The most commonly injured parts of the lacrimal excretory system are canaliculi (1). During examination of all ocular injuries 1.7% of patients reported with canalicular damage (2). In 70% of the canalicular trauma of lacrimal drainage system, 30% of the patients have been reported to have lacrimal sac and / or nasolacrimal duct damage (3). Also, 16% to 36% of the patients who developed traumatic eyelid laceration have been identified with nasolacrimal drainage system injury (4,5). Though both canaliculi can be affected by trauma, damage often occurs in single canaliculus, with lower canalicular damage being more often than upper one (6-8). Children and young people are reported to be more affected. Blunt trauma, stands out in the etiology (4-8).

Because of traumatic injury of nasolacrimal drainage system, treatment should be planned as soon as the canalicular damage is detected. In some cases especially those featured with edema treatment can be delayed for up to 24-48 hours. The purpose of this study was to evaluate clinical results of primary repair with silicone tube intubation after traumatic injury of lacrimal canaliculi.

MATERIALS and METHODS

This retrospective study included 15 patients with traumatic injury of lacrimal canaliculi who underwent primary repair surgery with silicone tube intubation in ophthalmology clinic at Afyonkarahisar Health Sciences University between January 2010 to May 2020. Institutional review board approval was obtained. The study was conducted in accordance with tenets of the Declaration of Helsinki.

Clinical records of the patients: age and gender, affected eye and canaliculi, causes of injury, time between trauma

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and surgery, other eye symptoms associated with injury, surgical technique, time between surgery and silicone tube removal, post-operative follow-up period, and anatomical as well as functional outcomes were retrieved from the patients' clinical records. The patients who did not attend post-operative control for at least 6 months were not included in the study.

Surgical Technique

Since size of the pigtail probe tip was bigger than punctum, initially so first extended punctum sound and punctal dilators and canaliculi, pigtail probe, entering the canaliculi through the puncta after passing through the common canaliculus was removed from the canaliculi distal to the laser (Figure 1). With 6/0 polypropylene suture after the suture to the hole of the end of the silicone tube pigtail probe also carefully passed the same milk silicone tube and silicone tube was removed from robust canaliculus when the pigtail withdrawn from the robust canaliculus. When applying the same procedure to damaged canaliculi and proximal portion of damaged canaliculi, also withdrawn pigtail probe by suturing to the other end of the same silicone tube removed from both punctum, and at the end 6/0 polypropylene suture is passed through silicone tubes' ends attaching each other before cutting the sutures and then sutures are cut (Figure 2 and Figure 3). Thus after more secure and controlled node taken to avoid the damage to the cornea of silicone tube the node part embedded on solid canaliculi to finish the work (Figure 4). Pericanalicular was sutured with skin subcutaneous tissue and 7/0 virgin skin tissue.

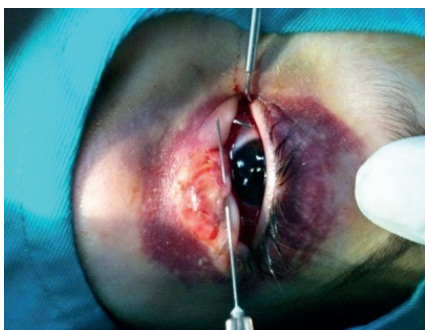


Figure 1. Placing the pigtail probe in patients with lower canalicular laceration with the cut on the lower lid

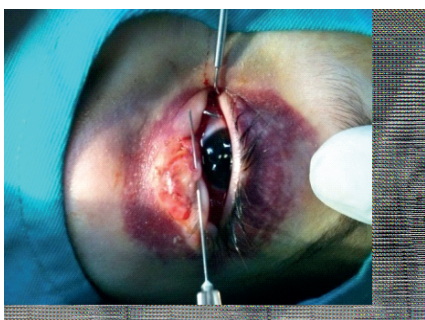


Figure 2. Appearance after silicone tube intubation with the help of pigtail probe

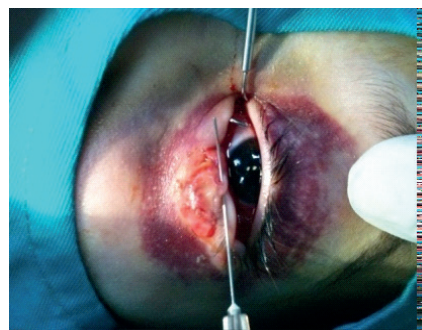


Figure 3. Connecting the silicone tube after the suturing of the lower lid incision

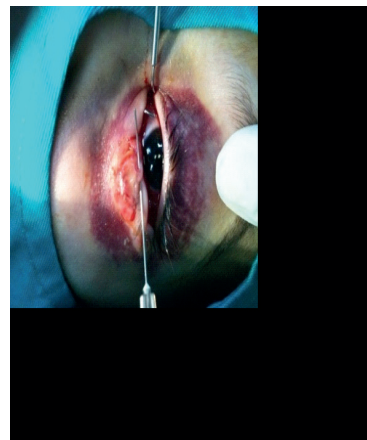


Figure 4. Appearance after silicone tube intubation in a patient having interrupted lower canaliculus

Pigtail probe accompanied silicone tube (Silicone tube BV Beaver-Visitec International, Waltham, USA) in the canalicular laceration repair and valve reconstruction in the required patients. Antibiotic drops (tobramycin, ofloxacin) 4 to 6 times a day to the postoperative and steroid drops (prednisolone) 4 to 6 drops were seen in two or three weeks prescribed.

While post-operative presence of non-hindered canalicular irrigation was considered as anatomic success, the absence of spontaneous ocular tearing was considered as functional success. Post-operative follow-up was performed on the 1st day, 1st week, 1st month, 4th month, and 6th month.

RESULTS

General clinical characteristics of the patients are summarized in Table 1. None of the patients had bulbus oculi damage. There were no difference between the BCVA during preoperative period and 6th month post-operative period. Isolated lower canalicular, upper canalicular, and both lower and upper canalicular injuries were revealed in 80%, 13.3%, and 6.7% of the patients, respectively. The mean time between traumatic injury and surgical primary repair was 13.8 hours (2-36 hours). Post-operative mean follow-up period was 18 months (6-24 months). The mean duration of the removal of the silicone tube was 5 months (2-7 months).

Table 1. Patient characteristics

Patient No	Age	Gender	Eye	Type of Injury	Affected Canaliculi	Duration of Surgery (Time)	Receipt of Tube	Follow-Up Time (Month)	Anatomic Success	Func. Success
1	17	M	L	Blunt	Lower	36	3 Month	12	Bad	Bad
2	40	F	R	Blunt	Upper and Lower	24	2 Month	12	Full	Full
3	60	M	R	Penetrating	Lower	5	6 Month	6	Full	Full
4	60	M	R	Penetrating	Lower	5	6 Month	6	Full	Full
5	25	M	R	Blunt	Lower	10	6 Month	6	Full	Full
6	4	M	L	Penetrating	Lower	6	4 Month	24	Full	Full
7	3	M	L	Blunt	Lower	4	6 Month	24	Full	Full
8	17	M	L	Penetrating	Lower	15	6 Month	24	Full	Full
9	7	M	R	Blunt	Lower	36	6 Month	24	Full	Full
10	30	M	R	Penetrating	Lower	4	6 Month	24	Full	Full
11	8	M	R	Blunt	Upper	16	6 Month	24	Bad Pteris	Bad
12	10	M	L	Blunt	Lower	24	6 Month	24	Bad	Bad
13	34	M	R	Blunt	Upper	2	6 Month	24	Full	Full
14	70	M	L	Blunt	Lower	14	7 Month	24	Full	Full
15	5	F	L	Blunt	Lower	6	2 Month	24	Full	Full

Table 2. Characteristics of prior surgeries performed in the literature

	Number of Cases	Surgery Technique			Age	Male %	Type of Trauma Blunt%	Etk Rate of Isolated Inferior Canaliculi %	Receipt of Tube (Month)	Follow-Up Time (Month)	Func Success %
		BA	BN	M							
Argin A et al	10	5	4	1	21	100	80	80	5.2	18	100
Ari S et al	62	62			12	66	48	67	4.7	8	90
Taskapili M et al	18	18				100		100	4		100
Yilmaz A et al	10		10		35	70		90	6	12	90
Ozay et al	12			12	26	83		50	5.5	17	100
Caca et al	26										
Demir T et al	20	20			30	75	60	65	5.7		95
Yener et al	20	20			15			70	4		95
Jordan DR et al	228				45	58	45				
Kennedy et al	222				20	74		66			
Jordan DR et al	236				23	78	46	52	?	?	?
Saunders et al	51	51				30		70			
Shu-Ya Wu et al	98		98		39	75		72	5		84
Mauriello ja et al	33			33							100
Serin et al	18				30			77			100

Eighty percent of the patients had successful anatomical as well as functional outcomes, but the outcomes were unsuccessful in three (20%) patients. Among these three patients, two were operated under local anesthesia and one developed pteris. Besides, these two patients reported to have been re-operated twice at another center. But status of the post-operative anatomical and functional success could not be acquired (Table 2).

DISCUSSION

The traumatic canalicular lacerations are common in young adults and males (9,14-16). Similar to previous

clinical studies, patients included in the present study had an average age of 26 years (3-70 years), and the majority of the patients (86%) were males. Regarding etiologies in the traumatic canalicular lacerations, blunt trauma was reported to be 84%, 80%, 48.4%, and 45.7% in the studies published by Wulc et al., Arkin et al., Bee et al., and Jordan et al., respectively (9,14,17,18). Correspondingly, the majority of the patients (66%) in the present study had active blunt trauma, the rest being diagnosed with penetrating injuries (33%).

Incidence of the traumatic injuries of isolated lower canaliculus has been reported to be higher in many clinical

studies (3,4,15). The study of 147 patients published by Kennedy et al., reported involved isolated sub-duct injuries in 66.2% of the cases. They also mentioned that epiphora occurred post-operatively significantly more often among patients with combined upper and lower canalicular injuries (61.5%) than among those with single canalicular laceration (19.7%). The epiphora was more common among adults than children when the pigtail probe had been used intra-operatively, or when no canalicular stent had been placed at the time of surgical repair.(19) In another studies published by Ari et al., Demir et al., and Yener et al., the ratios of the affected isolated lower canaliculus were 67%, 65%, 80%, respectively (9,20,21). Ari et al., reported anatomic success of 97% and both anatomical and functional success of 93%. Meanwhile Demir et al.,reported anatomic success rate of 100% and functional success of 95%. Only one patient with inferior canalicular incision had complaint of tearing, others had not complaint in the study conducted by Yener et al. Likewise, the majority of patients (80%) in the presents study had injury in the lower canaliculus compared to 13% and 6% of the patients who had injury of upper canaliculus, and of both canaliculi, respectively. Besides, 80% of the patients had successful anatomical as well as functional outcomes, although the outcomes were unsuccessful in three (20%) patients Generally, the majority of patients who undergo repair of canalicular lacerations have anatomic and functional and anatomic success. Functional success is considered the lack of epiphora post-operatively and ability to successfully irrigate the lacrimal system. Rarely, patients require a second surgery to treat the epiphora which may result from failure of canalicular laceration repair. This has mentioned in the present study in which 2 patients with persistant epifora underwent re-operation. Entropion, ectropion, and generally poor eyelid position may necessitate further surgery, although all these condition were absence in the present study. Patients may also develop ptosis that can be addressed surgically, depending on the degree of ptosis and the impact on the patient's quality of life. This condition was observed in one patients in the present study, but the degree of ptosis did not require surgical intervention.

In order to achieve firm nasolacrimal passage continuity in the canalicular laceration and creation of support to the tissues, soft materials for ensurance of correct anatomical wound healing and silicone materials with minimum allergic reactions are preferred. In the animal model study of Conlon et al., it was found that silicone intubation was necessary to re-establish patency of the canaliculus and that silicone intubation with and intubation without mucosal anastomosis were equally efficacious in restoring canalicular patency. Histopathologically, all canaliculi found to be patent by probing demonstrated mucosal continuity along the canalicular lumen (22). Surgical methods that use silicone material for repairing traumatic canalicular are divided into three groups, that is, bicanalicular annular intubation, bicanalicular nasal intubation, and monocanalicular intubation technique.

In the bicanalicular annular intubation technique silicone tube is applied to all the nasolacrimal system. On the other hand, in bicanalicular nasal intubation technique silicone tube is applied to lower, upper and common canalicular. And, in monocanalicular intubation technique silicone tube is applied just to traumatized canalicula (14,23-25). It has been reported in the study published by Arkin et al., that successful results could be achieved with each of the three techniques if were to be performed by experienced surgeons (14). Despite the much shorter operation time in the monocanalicular intubation technique the tube may come out earlier from the incision area, and thus, the success is less likely (25). Contrarily, the study conducted in Turkey by Ozay et al., in which monocanalicular intubation technique was performed reported 100% rate of success (24). There are several varieties of lacrimal stents and surgical approaches which successfully repair canalicular lacerations and avulsions. The instruments and surgical techniques utilized may be chosen based on a case-by-case basis so that they are catered to the individual patient. The Mini Monoka monocanalicular stent has become a popular method to repair simple monocanalicular lacerations. Bicanalicular lacerations may be repaired using two Mini Monoka stents, or a bicanalicular stent. The Crawford and Ritleng are two of the most popular bicanalicular stents. The present study investigated cases in which Pigtail probe accompanied-silicone tube was employed in the canalicular laceration repair and valve reconstruction.

Other studies reported success rate ranging from 84% to 100% following bicanalicular intubation procedure due to canalicular laceration (14,23). Unlike other techniques, the need for collaboration with an otolaryngologist in bicanalicular intubation technique bears a significant drawback. Moreover, complications such as punctal erosion, cicatricial entropion and granuloma formation have been reported following bicanalicular nasal intubation technique (23).

Yilmaz et al., reported 90% success rate in 10 patients who underwent nasal bicanalicular intubation technique (16). Similar to bicanalicular annular intubation technique there is a possibility of iatrogenic injury and the the risk of false passage is substantially high.

The success rate of the bicanalicular annular intubation technique reported in literature ranges from 30% to 100%. While the study conducted in 51 patients by Saunders et al., reported 30% success rate following bicanalicular annular intubation technique, (11) Taskalpli et al., revealed a 100% success rate in 18 patients with injured lower canaliculus (15).

Most of the clinical studies conducted in Turkey concerning bicanalicular annular intubation technique reported surgical success rates ranging from 90% to 100% (9,14,16,21). Yilmaz et al., reported anatomic and functional success following bicanalicular nasolacrimal intubation of 90%. Yener et al., on the other hand, reported

anatomical and functional success rates of 100% and 95%, respectively (16,21). The present study in which bicanalicular annular intubation method was applied revealed 80% success rate in terms of anatomic and functional outcomes, as mentioned above.

Localization of injury site is another factor that affects the likelihood success of the reconstructive nasolacrimal canalicular intubation procedure. Probability of success in patients with medial or near punctum is expected to be lower. Negative results have been reported from patients with close incisions to lower punctum.

There are different opinions on the timing of surgery after traumatic injuries of the lacrimal canalicular duct. Gunenc et al., argued that 16-24 hours following the trauma injury is associated surgical difficulty due to increased edema in the surrounding tissues (26). On the other hand, the study of 222 cases published by Kennedy et al., reported that the time period between traumatic injury and surgery has nothing to do with post-operative outcome success (19). Similarly, Hanselmay study reported no difference in surgical results and success rate when compared surgical procedures performed during the first 6 hours and 7-48 hours (27). Hawes et al., went further by arguing that the success of the surgical procedure still can be attained within the first 5 days of canalicular laceration (28). However, Jordan et al., mentioned positive results in patients operated 7-10 days after trauma (29). In the study conducted by Ari et al, on the other hand, there were three unsuccessful patients, two of underwent reconstructive surgery 48 hours following trauma. Consequently, the time period less than 48 hours from canalicular injury to surgery has been emphasized by the authors as an important factor that increases the success of the surgery (9).

Silicone tube should be kept in place until mucosal wound healing is complete. Regarding the removal time of the intubated silicone from the pre-operated lacrimal canaliculi, Conlon et al., mentioned in their animal study that the rate of canal opening is higher when tubes removed during 12th week than in 4th or 8th week after surgery (22). On the other hand, the study published by Yilmaz et al., reported that post-operative period of 6th month prior to removal of the silicone tube was effective with respect to the anatomical and functional outcomes (16). Contrarily, Caca et al., claimed that being an inert material silicone tube can stay constantly for canal integrity (30). In the present study the average time of tube removal following surgery was 5 months.

LIMITATION

The limitation of our study is that alternative surgical methods such as canal repair operations with mini-monaco tubes were not used in the patients with unilateral canalicular injury. Another limitation of our study is that only clinical record of the surgeries performed within 10-year period were examined. Additionally, all evaluated surgical procedures examined were not performed by the same surgeon.

CONCLUSION

Conclusively, traumatic injuries of the lacrimal canalicular system are more common in economically active age range. Following traumatic injuries of canaliculi, detailed ophthalmologic examination should be performed for canalicular lacerations. In case of canalicular laceration, primary reconstruction should be performed under general anesthesia as soon as possible. In the reconstruction of the lacerated canaliculi by applying silicone tube with the help of pigtailed, there is possibility of higher anatomical as well as functional success.

Competing Interests: The authors declare that they have no competing interest.

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