Efficacy of Monocanaicular Intubation in Management of Proximal Versus Distal Lacrimal Canalicular Laceration

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Abstract:

Purpose: To detect the effect of laceration depth on the surgical outcomes of monocanalicular intubation in cases of lacrimal monocanalicular laceration and to detect the association between the distance of lacrimal canalicular laceration and other preoperative clinical characteristics.

Patient and Methods: A retrospective review was done for the medical records of 60 patients who underwent primary repair of lacrimal monocanalicular laceration by Mini-monoka monocanalicular lacrimal intubation. The patients were divided into two groups: Group I: included patients underwent repair of proximal canalicular laceration and group II: included patients who underwent repair of distal canalicular laceration. Demographic data were collected, etiology of injury, depth of laceration, interval between injury and surgical repair, duration to stent removal. Patients were followed regularly on 1st day, 1 week, and every month up to 6 months after the procedure and 3 months after stent removal. At the end of follow up period anatomical success was defined as negative fluorescein dye disappearance test and patent canaliculus on irrigation of lacrimal passages. Functional success was defined as absence of tearing.

Results: Patients' sex, age, etiology of trauma, time to stent removal, interval between trauma and surgical repair were not found to have a statistically significant difference between both groups. There was a significant difference between both groups regarding associated injuries (P< 0.001).Complete anatomical success was achieved in 30 patients (83.3%) in group I and 12 patients (50%) in group II. There was significant difference between studied groups regarding anatomical success (P=0.009). Complete functional success was achieved in 26 patients (72.2%) in group I and 14 patients (58.3%) in group II. There was a significant difference between studied groups regarding functional success (P=0.01). There was significant difference between studied groups regarding risk of granuloma formation and structural deformity of the medial canthal region (P=0.001) and (P=0.004) respectively.

Conclusions: Surgical outcome of lacrimal canalicular laceration repair is affected by the depth of laceration. This study reported better anatomical and functional outcomes with minimal postoperative complications in proximal canalicular laceration compared to distal canalicular laceration. Associated injuries are more common in distal lacrimal canalicular lacerations than proximal lacrimal canalicular lacerations.

Keywords: Monocanalicular intubation**;** Proximal canalicular lacetaions; Distal canalicular lacerations; Mini-Monoka stent; medial canthal deformity.

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1. Introduction

Absence of tarsal support in the lacrimal portion of the eyelid increases the risk of lacrimal canalicular injury. [1, 2]. Canalicular lacerations can be caused by direct piercing or indirect diffuse blunt trauma. [3]. Singh et al reported better anatomical success in proximal laceration because of the challenges that can be met during distal laceration repair like detection of the medial cut end and suturing it [4].

Precise identification of the medial lacerated end can be aided by early stenting before development of tissue edema [5]. The most important issue in repair an injured canaliculus is placement of a stent to help proper mucosal healing and preserve canalicular patency [6].

However; controversy exists as regard repair of monocalicular laceration, there are recommendations to repair even monocanalicular lacerations to prevent intermittent epiphora [7]. Over the past decades, there were various adjustments in the procedures of canalicular repair. Chu et al. reported that direct canalicular wall suturing provides higher success rate [8]. Kersten and Kulwin reported 95.5% success with one-stitch canalicular repair [9]. Monocanalicular intubation techniques become popular to avoid risk of injury of intact canaliculus [10].

The Mini Monoka ® is a monocanalicular self retaining stent (FCI Ophthalmics, USA). It is easy to be inserted and removed because it has a PFD (proximal fixation device) at its proximal end [11].

The aim of this study was to detect the effect of laceration depth on the surgical outcomes of monocanalicular intubation and to detect the association between the depth of laceration and other preoperative clinical characteristics.

2. Patient and Methods

In this retrospective study, medical records of 60 patients who underwent lacrimal monocanalicular intubation for repair of lacrimal monocanalicular lacerations were reviewed and analyzed. The study was done consistent with the principles of the Declaration of Helsinki with organization from the Ethical Committee of Faculty of Medicine, Zagazig university and an Institutional Review Board (IRB) was taken. Written consent was taken from all the patients or their parents. All operations were completed in the Ophthalmology Department, Faculty of Medicine, Zagazig University.All procedures were done using operating microscope under general anesthesia. The patients were divided into 2 groups: proximal laceration group (I) <6 mm and distal laceration group (II) ≥6 mm depending on the measured distance between punctum and lateral cut end of the canaliculus.

Patients who presented with single lacrimal canalicular were included in our study. Patients presented with bicanalicular laceration or reported history of lacrimal problems or medial canthal structural abnormalities, were excluded from this study. Complete ophthalmic examination was done. Demographic data of the patients, etiology of canalicular laceration, other injuries, interval between injury and repair, scheduling of stent extraction and postoperative complications all were analyzed

After identification of the medial injured end the canaliculus, the punctum was dilated and a Bowman lacrimal probe was passed through the injured canaliculus till reaching a hard stop. A part about 13 mm of the stent was cut and the stent was advanced though the punctum. The stent was pulled out of the lacerated canaliculus until the head of the stent become stable above the punctum. After that the stent was advanced through the medial injured end of the canaliculus then into the lacrimal sac. The peri-canalicular tissue was sealed using 6-0 Vicryl suture. The eyelid skin wound was sealed using 6-0 silk suture.

Broad spectrum systemic antibiotic was given for one week and topical combination of antibiotic and steroid was given for two weeks to avoid adhesions and infection. The skin sutures were removed after 2 weeks.

Patients were followed up at 1st day, 1 week and every month up to 6 months postoperatively. Stent was removed after 6 months and surgical outcome was evaluated 9 months postoperatively. The outcome measures were grades of epiphora [12], Fluorescein dye disappearance test results and irrigation test. Postoperative complications including punctum or canaliculus slitting, puctum granuloma, structural deformity of the medial canthal region and premature stent extrusion were assessed and compared

3. Results

Demographic data were summarized in (Table 1). There were no significant differences between studied groups.

Clinical characteristics of patients who underwent monocanalicular intubation for monocanalicular lacerations primary repair including; etiology of injury, canaliculus involved, interval between injury and surgery and associated injuries were summarized in (Table 2). There were no significant differences between studied groups regarding etiology of injury, canaliculus involved and interval between injury and surgery. However there was a significant difference between studied groups regarding and concurrent injuries ($P< 0.001$).

There was a significant difference between studied groups regarding anatomical success ($P=0.009$) and functional success ($P=0.01$) (Table 3).

Regarding postoperative complications, premature stent extrusion was reported in 6 patients (16.7%) group I and 2 patients in group II (8.3%). There was no significant difference between studied groups regarding premature stent extrusion ($P=0.352$) (Table 4). In group I; the first extrusion happened in a 5 years-old patient at 3 months after operation due to patient-removal of the stent. Lacrimal irrigation test was done and it revealed patent canaliculus. Two cases, an 11 years old patient and 14 years old boy presented with stent extrustion when attended for follow up 1 month after operation. Lacrimal irrigation test was done and it revealed obstructed canaliculus. The other three cases of extrusion occurred at 4, 3.5 and 4.5 months after the operation. Lacrimal irrigation was done and it revealed patent canaliculus. In group II; the first extrusion happened in an 5 years-old patient, 8 days after operation due to patient-removal of the stent. Stent reposition was done and the stent was left in place for 6 months. The second extrusion happened in a 4 years-old patient, 3 weeks after operation due to patient-removal of the stent. Stent reposition was done and the stent was left in place for 6 months.

No patients reported punctum granuloma in group I, and 5 patients (20.8%) reported punctum granuloma in group II. Four cases were treated successfully with topical steroids and only one case required surgical excision. There was a significant difference between studied groups ($P=0.004$) (Table 3).

Regarding medial canthal region deformities, No patients reported medial canthal region deformities in group I, and 5 patients (20.8%) reported medial canthal region deformities in group II. They were in the form of 2 cases of lacrimal punctum lateral displacement, 3 cases of lower lid ectropion. There was a significant difference between studied groups ($P=0.004$) (Table 3).

Table (1): Demographic characteristics of the studied groups:

Variable	Group I (Proximal laceration) (N=36)	Group II (Distal laceration) (N=24)	Test	P value
Age:				
Median	8.5	22	-1.08#	0.280
Range	3 – 55	2.5 - 51		
Sex:				
Female:	14 (38.9%)	8 (33.3%)	0.191^	0.661
Male:	22 (61.1%)	16 (66.7%)		(NS)

NS: non-significant (p≥ 0.05). ^: Chi-square test. #: Mann-Whitney test.

Table (2): Clinical characteristics of the studied groups:

Variable	Group I (Proximal laceration) (N=36)	Group II (Distal laceration) (N=24)	Test	P value
Site of laceration:				
Lower:	24 (66.7%)	20 (83.3%)	2.045^	0.152
Upper:	12 (33.3%)	4 (16.7%)		(NS)
concurrent injuries:				
No:	26 (72.2%)	6 (25%)		
Brow wound:	2 (5.6%)	4 (16.7%)	25.8^	<0.001
Commotio retina:	0 (0%)	4 (16.7%)		(HS)
Fracture neck:	0 (0%)	2 (8.3%)		
Globe injury:	4 (11.1%)	4 (16.7%)		
Vitreous hemorrhage:	0 (0%)	2 (8.3%)		
Orbital floor fracture:	0 (0%)	2 (8.3%)		
Sub-conjunctival hemorrhage:	4 (11.1%)	0 (0%)		
Type of injury:				
Direct:	12 (33.3%)	6 (25%)	0.476^	0.490
Indirect:	24 (66.7%)	18 (75%)		(NS)
Time between injury and repair:				
Median	16	22.5	-1.505#	0.132
Range	8 – 27	9 – 48		(NS)

NS: non-significant (p≥ 0.05). ^: Chi-square test. #: Mann-Whitney test.

Table (3): Surgical outcomes of the studied groups:

Variable	Group I (Proximal laceration) (N=36)	Group II (Distal laceration) (N=24)	Test	P value
Anatomical success:				
Complete:	30 (83.3%)	12 (50%)	9.286^	0.009
Partial:	4 (11.1%)	4 (16.7%)		(S)
Failure:	2 (5.6%)	8 (33.3%)		
Functional success:				
Complete:	26 (72.2%)	14 (58.3%)	8.75^	0.01
Partial:	8 (22.2%)	2 (8.3%)		(S)
Failure:	2 (5.6%)	8 (33.3%)		
Premature stent loss:				
Present:	6 (16.7%)	2 (8.3%)	0.865^	0.352
Absent	30 (83.3%)	22 (91.7%)		(NS)
Complications:				
Granuloma:	0 (0%)	5 (20.8%)	10.00^	0.004
				(S)
Medial canthal region				
deformity	0 (0%)	5 (20.8%)	8.182^	0.004
Present:	36 (100%)	19 (79.2%)		(S)
Absent:				

NS: non-significant (p≥ 0.05). ^: Chi-square test. #: Mann-Whitney test.

4. Discussion

There are many surgical methods offered for primary repair of a lacerated lacrimal including bicanalicular nasal intubation**,** bicanalicular nasal intubation and monocanalicular intubation [13] [14].

Monocanalicular intubation converted widespread since 1992. Monocanalicular intubation is easier and preserves the uninjured portion of the lacrimal excretory system [15].

This study evaluated the association between the depth of lacrimal canalicular laceration and other preoperative clinical characteristics and its impact on the surgical outcomes.

In this study the mean age at time of injury was 8.5 years (range 3-55) in proximal laceration group and 22 years (range 2.5-51) in distal laceration group. In this study no association was found between age and distance of laceration. [10]. Kim et al reported a 19.3 years old mean age of their patients [16]. This support the proposal that lacrimal drainage system injuries are more mutual in young patients.

Gender distribution in this study showed male predominance 61.1% in proximal laceration group and 66.7% in distal laceration group. In this study no association was found between sex and distance of

laceration. Our result is comparable to that has been described previously, Lee et al reported male predominance (72%) [17], and Lin et al reported that males were (75%) in their study [1].

In this study, the lower canaliculus was involved in 66.7% in proximal laceration group and in 83.3% in distal laceration group. [10] Lin et al reported that the lower canaliculus was affected in 77.1% [1]. This confirm that lower canaliculus is more susceptible to injuries. In this study no association was found between the canaliculus involved and the distance of laceration but the study found that distal canalicular laceration is more common in lower lid (83.3%) compared to distal canalicular laceration in the upper lid (16.7%).

This study reported concurrent injuries in 27.8% in proximal laceration and in 75% in distal laceration indicating that distal lacerations are more commonly associated with concurrent injuries than proximal lacerations. Serious injuries including, injury of the globe and orbital walls fractures are more commons with indirect trauma [18]. Singh, et al reported simultaneous injuries in 47.2% [19]. Kim et al reported simultaneous injuries in 26.0% [16].

The best optimum of stent removal is still undifined ranging from 3 months to 12 months. Conlon et al reported that the ideal time for stent removal is 12 weeks depending on histological healing changes in animals [20]. Naik et al stated that the risk anatomical failure increases with early stent extrusion [21]. In our study stents were kept in place for 3 months at least and the most were extracted after 6 months in both groups..

In this study after follow up for 9 months, there was significant difference between proximal lacrimal canalicular laceration and distal lacrimal canalicular laceration regarding the anatomic and functional success with complete anatomic (83.3%) and functional success (72.2%) in proximal laceration group and complete anatomic (50%) and functional success (58.3%) in distal laceration group.

Lin et al studied reported an anatomical success rate of 94.1% in moderate laceration and 83.9% in deep laceration after monocanalicular intubation.. They postulated that this difference was due to poor canalicular anastomosis due to challenging identification of medial injured end of the canaliculus and incorrect placement of suture [1].

[4]. Qin et al reported that functional failure increases with increased laceration depth and with more deformities of the medial canthal region. They proposed that lacrimal pump malfunction occurs due to injury of Horner's muscle [22]. The previous studies postulated that distal lacrimal canalicular lacerations increase the risk of anatomical failure. Our results are comparable with the previously mentioned studies.

This study reported premature stent extrusion in 6 [17]. Kim et al reported premature stent loss in 7.8% of their patients [11]. Naik et al reported in 11.1% of their patients [23]. Our results regarding premature stent extrusion are similar to the previously mentioned studies..

Punctum granuloma was recorded in 5 patients (20.8%) in group II. Alam et al described punctal granuloma in 3.45% [10]. Singh, et al described punctum granuloma in 11.1% [19].

5. Conclusions:

In conclusion, depth of canalicular laceration has an effect on both anatomical and functional success. This study reported better anatomical and functional outcomes with minimal postoperative complications in proximal canalicular laceration compared to distal canalicular laceration. Concurrent

injuries are more common in distal lacrimal canalicular lacerations than proximal lacrimal canalicular lacerations.

Author Contributions

All authors contributed significantly to work reported, whether in the conception, study design, execution, data acquisition, analysis, and interpretation, or in all of these areas; participated in the drafting, revising, or critically reviewing of the article; gave final approval of the version to be published; agreed on the journal to which the article was submitted; and agreed to be accountable.

Data Availability Statement:

Available upon request from the corresponding author.

Conflicts of Interest:

The authors declare no conflicts of interest.

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