

Epiphora after nasolacrimal duct fracture in patients with midfacial trauma

A retrospective study

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Abstract

The aim of this study was to identify the factors related to occurrence of epiphora or requirement of dacryocystorhinostomy (DCR) in patients with midfacial trauma.

We performed a retrospective analysis of the medical records of 1038 patients with midfacial trauma from January 2005 to December 2015. Fifty-one patients (55 cases) diagnosed with nasolacrimal duct (NLD) fracture using facial bone computed tomography were enrolled. Correlation analysis was performed of patient- and injury-related factors, including age, sex, facial trauma etiology, accompanying injury, type and level of the NLD fracture, and time from injury to initial surgery, with the occurrence of epiphora and requirement for DCR.

Epiphora occurred in 14.5% and DCR was performed in 5.5% of the patients with NLD fracture. The correlation analysis revealed no significant relationship among the factors with the occurrence of epiphora and requirement for DCR.

In patients with midfacial trauma and NLD fracture, epiphora occurred in 14.5% and endoscopic DCR was performed due to persistent epiphora in 5.5% and its result was all successful.

Abbreviations: DCR = dacryocystorhinostomy, NLD = nasolacrimal duct, NOE = naso-orbitoethmoid.

Keywords: dacryocystorhinostomy, epiphora, midfacial trauma, nasolacrimal duct

1. Introduction

Fracture of the nasolacrimal duct (NLD) occasionally occurs in cases of midfacial trauma, but is often overlooked. Although these fractures can be easily diagnosed using computed tomography, it is difficult to predict whether NLD obstruction will develop.

Epiphora in the early stage of trauma may be caused by facial and conjunctival edema, NLD obstruction, or reactive hypersecretion due to pain. As the facial edema and hypersecretion usually resolve quickly, the accompanying epiphora may improve in a relatively short time, but that due to NLD obstruction can last

for months. The NLD obstruction after injury may be temporary and spontaneously recover over time; however, development of prolonged obstruction is possible due to soft tissue stricture, adhesions, or bony remodeling.

It is difficult to approach the NLD at the time of initial treatment; in fact, the attempt itself may worsen the injury. Currently, there is no consensus on which method should be practiced. Several studies have reported that lacrimal intubation is a useful prophylactic procedure at the time of injury^[1–3] to prevent NLD obstruction, whereas other studies have recommended delayed assessment.^[4–6]

In this study, we aimed to identify any factors related to the occurrence of epiphora or the requirement for dacryocystorhinostomy (DCR) in patients with midfacial trauma.

2. Materials and methods

This study was approved by the Institutional Review Board of the Chungbuk National University Hospital and it adhered to the tenets of the Declaration of Helsinki. The requirement for patient consent was waived due to the study's retrospective nature.

We reviewed the medical records of 1038 patients with midfacial trauma from January 2005 to December 2015. Fifty-one patients diagnosed with NLD fracture using facial bone computed tomography were enrolled. Patients who had prior facial trauma or history of facial surgery were excluded. The average follow-up period was 5.7 years (range, 6 months–10 years).

The etiology of the facial trauma, co-existence of an accompanying injury, type and level of the NLD fracture, the time from injury to initial surgery (days), epiphora occurrence and duration (months), and DCR performance were reviewed for each patient. None of the patients underwent prophylactic DCR

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WSS and MJC contributed equally to this study.

The authors have no conflicts of interest to disclose.

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Table 1
Characteristics of patients with nasolacrimal duct fracture.

Characteristic	No. of cases (%)
Sex	
Male	46 (83.6)
Female	9 (16.4)
Etiology	
Fall	22 (40)
Traffic accident	20 (36.4)
Physical assault	13 (23.6)
Accompanying injury	
Multiple	30 (54.5)
Naso-orbitoethmoid	14 (25.5)
Tripod	11 (20)
Nasolacrimal duct fracture type	
Complex	34 (61.8)
Linear	20 (36.4)
Avulsion	1 (1.8)
Nasolacrimal duct fracture level	
Postsaccal	41 (74.5)
Saccal	14 (25.5)
Epiphora occurred	8 (14.5)
Dacryocystorhinostomy required	3 (5.5)

or lacrimal intubation. Patients whose epiphora symptoms persisted for more than 3 months underwent dacryocystography to confirm obstruction.

Accompanying injury was classified as a zygomaticomaxillary complex fracture (tripod fracture), naso-orbitoethmoid (NOE) complex fracture, or multiple fractures, defined as either a tripod or an NOE fracture accompanying a Le Fort fracture. The type of NLD fracture was classified as a simple linear, comminuted, or avulsion. An avulsion fracture existed when part of the bone was broken off or “avulsed” from the rest of the bone. The level of the NLD fracture was divided into saccal or postsaccal.

Patients were divided into 3 groups: those without epiphora, those with epiphora that resolved spontaneously within 3 months, and those who underwent DCR due to epiphora that persisted for more than 3 months. The Fisher exact test and Cochran *Q* test were performed to determine whether any factors, except age and time from injury to surgery, were significantly related to epiphora occurrence or DCR requirement. For the age and time from injury to surgery, Mann–Whitney test and Kruskal–Wallis test were performed using the same grouping method mentioned above. *P*-values <.05 were considered significant. Data analyses were performed using SPSS, version 21.0 (SPSS Inc, Chicago, IL).

3. Results

A total of 55 cases (51 patients) of NLD fracture were included in this study (4 patients had bilateral NLD fractures). Demographic analysis revealed that there were 46 male patients (83.6%) and 9 female patients (16.4%) with an average age of 34.2 years (range, 9–72 years). The average time from injury to initial surgery was 6.3 days (range, 0–17 days). A fall was the most common cause of trauma (22 cases, 40%). The most common accompanying injury, type of NLD fracture, and level of NLD fracture were multiple fractures (30 cases, 54.5%), complex (34 cases, 61.8%), and postsaccal (41 cases, 74.5%), respectively. Epiphora was present in eight patients (14.5%), of which only 3 (5.5%) underwent dacryocystography due to persistent epiphora. All 3 patients were confirmed to have NLD obstruction and underwent endoscopic endonasal DCR (Table 1). They all remained symptom-free during a follow-up period of 2, 5.5, and 7 years.

The analysis among the three groups (epiphora [–], epiphora [+]/DCR [–], and epiphora [+]/DCR [+]) revealed no significant relationships among the factors (Table 2). Furthermore, we performed an inter-group analysis between epiphora (–)/epiphora (+) and DCR (+)/DCR (–), which also revealed no significant relationships (Tables 3 and 4). Age, sex, the facial

Table 2
Analysis of patients according to the epiphora occurrence and the requirement of dacryocystorhinostomy.

Characteristic	Group			<i>P</i> -value
	Epiphora(–)	Epiphora(+) / DCR(–)	Epiphora(+) / DCR(+)	
Sex				.538
Male	40 (72.7%)	4 (7.3%)	2 (3.6%)	
Female	7 (12.7%)	1 (1.8%)	1 (1.8%)	
Age, mean ± SD, yr	33.59 ± 18.05	39.4 ± 14.38	34.67 ± 16.65	.599
Etiology				.884
Fall	19 (34.5%)	2 (3.6%)	1 (1.8%)	
Traffic accident	18 (32.7%)	1 (1.8%)	1 (1.8%)	
Assault	10 (18.2%)	2 (3.6%)	1 (1.8%)	
Accompanying injury				.499
Multiple	24 (43.6%)	3 (5.5%)	3 (5.5%)	
NOE	12 (21.8%)	2 (3.6%)	0 (0.0%)	
Tripod	11 (20.0%)	0	0	
NLD fracture type				.515
Complex	29 (52.7%)	4 (7.3%)	1 (1.8%)	
Linear	17 (30.9%)	1 (1.8%)	2 (3.6%)	
Avulsion	1 (1.8%)	0	0	
NLD fracture level				.418
Postsaccal	34 (61.8%)	5 (9.1%)	2 (3.6%)	
Saccal	13 (23.6%)	0	1 (1.8%)	
Time from injury to surgery, mean ± SD, d	8.55 ± 16.57	6.20 ± 3.19	5.33 ± 4.04	.927

Data are presented as n (%) unless otherwise noted; Kruskal–Wallis test for continuous variables and Cochran *Q* test for categorical variables were used for statistical analysis. DCR = dacryocystorhinostomy, NLD = nasolacrimal duct, NOE = naso-orbitoethmoid.

Table 3
Analysis of patients according to the occurrence of epiphora.

Characteristic	Group		P-value
	Epiphora (-)	Epiphora (+)	
Sex			.604
Male	40 (72.7%)	6 (10.9%)	
Female	7 (12.7%)	2 (3.6%)	
Age, mean \pm SD, years	33.60 \pm 18.05	37.62 \pm 14.26	.848
Etiology			.558
Fall	19 (34.5%)	3 (5.5%)	
Traffic accident	18 (32.7%)	2 (3.6%)	
Assault	10 (18.2%)	3 (5.5%)	
Accompanying injury			.346
Multiple	24 (43.6%)	6 (10.9%)	
NOE	12 (21.8%)	2 (3.6%)	
Tripod	11 (20.0%)	0	
NLD fracture type			1.000
Complex	29 (52.7%)	5 (9.1%)	
Linear	17 (30.9%)	3 (5.5%)	
Avulsion	1 (1.8%)	0	
NLD fracture level			.664
Postsaccal	34 (61.8%)	7 (12.7%)	
Saccal	13 (23.6%)	1 (1.8%)	
Time from injury to surgery, mean \pm SD, d	8.55 \pm 16.58	5.87 \pm 3.27	.958

Data are presented as n (%) unless otherwise noted; Mann-Whitney test for continuous variables and Fisher exact test for categorical variables were used for statistical analysis.

NLD = nasolacrimal duct, NOE = nasoorbitoethmoid.

trauma etiology, accompanying injury, type and level of the NLD fracture, and the time from injury to surgery showed no significant relationship with the occurrence of transient or permanent epiphora.

Table 4
Analysis of patients according to the requirement of dacryocystorhinostomy.

Characteristic	Group		P-value
	DCR (-)	DCR (+)	
Sex			.421
Male	44 (80.0%)	2 (3.6%)	
Female	8 (14.5%)	1 (1.8%)	
Age, mean \pm SD, yr	34.15 \pm 17.70	34.67 \pm 16.65	.986
Etiology			1.000
Fall	21 (38.2%)	1 (1.8%)	
Traffic accident	19 (34.5%)	1 (1.8%)	
Assault	12 (21.8%)	1 (3.6%)	
Accompanying injury			.409
Multiple	27 (49.1%)	3 (10.0%)	
NOE	14 (25.5%)	0	
Tripod	11 (20.0%)	0	
NLD fracture type			.572
Complex	33 (60.0%)	1 (1.8%)	
Linear	18 (32.7%)	2 (3.6%)	
Avulsion	1 (1.8%)	0	
NLD fracture level			1.000
Postsaccal	39 (70.9%)	2 (3.6%)	
Saccal	13 (23.6%)	1 (1.8%)	
Time from injury to surgery, mean \pm SD, d	8.33 \pm 15.79	5.33 \pm 4.04	.740

Data are presented as n (%) unless otherwise noted; Mann-Whitney test for continuous variables and Fisher exact test for categorical variables were used for statistical analysis.

DCR = dacryocystorhinostomy, NLD = nasolacrimal duct, NOE = nasoorbitoethmoid.

4. Discussion

NLD fracture is mainly observed in patients with extensive midfacial trauma. Although it is not difficult to diagnose, the complication of permanent epiphora is hard to predict. In a recent large study, patients with craniofacial trauma were evaluated to predict the occurrence of epiphora; however, this study focused mainly on the patterns of the nasolacrimal system fractures.^[7] To the best of our knowledge, this is the first study to analyze multiple factors of patients with midfacial trauma that could predict the occurrence of epiphora and the requirement for DCR.

Our study showed that 14.5% of the patients with NLD fractures experienced epiphora and 5.5% of them underwent endoscopic DCR due to persistent epiphora. These rates are lower than those reported in prior studies, wherein epiphora was reported in 45.7% to 46.5% and DCR in 17.4% to 29.3% of the cases.^[5,6] These differences are plausible as our study investigated all NLD fractures regardless of the fracture type, whereas prior studies focused on NOE fractures, which have been related to a higher incidence of NLD obstruction than that in other facial bone fractures.^[6,8-10] When analyzing only the patients with NOE fractures and multiple fractures in our study, 18.2% experienced epiphora and 6.8% underwent endoscopic DCR, which are still lower rates than those in the prior studies. Another factor that might have contributed to these differences is the short time delay between the injury and the surgery. Previous studies have found that it is important to repair facial bone fractures within 2 weeks and that delayed treatment might lead to a permanent dysfunction of the lacrimal drainage.^[5,11] In another study by Uraloğlu et al, the authors found that early fracture reduction helps to prevent nasolacrimal system laceration or compression and that reduction itself increases the success rate of DCR.^[12] In our study, patients underwent reduction and fixation within an overall average of 6 days, which may have contributed to low rate of epiphora occurrence and requirement of DCR. A recent study of craniofacial trauma had similar results, including surgical reduction performed within an average of 5 days, epiphora observed in 10.6%, and DCR performed in 1.9% of the patients.^[7]

Until recently, NLD fractures were corrected simultaneously with other major fractures. However, there have been recent disputes regarding the treatment approach for these fractures between early correction and delayed assessment. Toshinori et al conducted a study in 13 patients (16 sides) who underwent intraoperative lacrimal intubation to prevent epiphora; the intervention was successful in all cases.^[1] Mukherjee et al performed a similar study in 28 patients with traumatic NLD obstruction who underwent external DCR as a delayed assessment; their study showed a 96% success rate.^[4] Unfortunately, those studies did not have a control group and the severity of the NOE fractures was not described.

In our opinion, delayed assessment has come to the forefront rather than early correction considering that it is difficult to approach the NLD in the early phase of treatment. Moreover, it is very difficult to clinically discern mucosal injury and laceration. Although the NLD pathway may be intact despite surrounding bony fractures, a distinct obstruction may still occur due to soft-tissue edema, mucosal swelling, and external compression caused by displacement of bone fragments. These situations can lead to dysfunction of the NLD that can recover spontaneously within several months after trauma. For this reason, it is reasonable to apply delayed assessment and surgical correction of NLD obstruction.^[6,12]

Noninvasive procedures, such as experimental probing and NLD lavage, have been presented in the assessment of NLD injury. However, such approaches still have the potential of worsening the pre-existing injury as they might scar the mucosal lining or induce infection. Moreover, mucosal edema or the NLD fracture itself could be an obstacle in such procedures. In contrast, dacryocystography is very useful for establishing a diagnosis as well as acquiring information on the surrounding bony system, the size of the intranasal opening, the state of the lacrimal canaliculus, and the size and position of the lacrimal sac.^[6]

Traumatic NLD obstruction is usually treated by therapeutic probing and DCR. Nonetheless, therapeutic probing is used restrictedly because the obstruction might be due to scarring, fibrosis, displacement of a thick bone fragment, or severe distortion of the NLD. Surgical treatment by external or endonasal DCR is commonly performed 3 to 6 months after the initial treatment.^[5] The success rate of the endonasal approach has reached 85% to 95.6% in previous studies,^[13–15] similar to the findings of a recent study of external DCR showing a 93% success rate.^[16] In our study, three patients underwent endoscopic endonasal DCR and are symptom-free up to date.

Although we could not identify any significant factors that might help to predict epiphora occurrence or DCR requirement, we did find that 85.5% of patients with midfacial trauma and NLD fracture did not experience epiphora and 94.5% did not require DCR. This may suggest that early NLD assessment and prophylactic procedures, such as lacrimal intubation, which might worsen the pre-existing injury, are unnecessary, regardless of the severity of the trauma. Therefore, we would like to recommend delayed assessment until the lacrimal system becomes stable, and, if necessary, an endoscopic endonasal DCR approach, because it has a high success rate and does not cause esthetic complications as external DCR might.

There are a few limitations to the present study. It was not performed as a prospective study and since none of the patients underwent prophylactic DCR or lacrimal intubation, we could not provide direct data to compare different methods. Therefore, multicentered studies involving a greater number of patients and using a comparative tool could verify the benefit of delayed NLD assessment. Moreover, studies comparing endonasal endoscopic DCR and external DCR would help to elucidate the best strategy for persistent epiphora after NLD fracture.

5. Conclusion

In conclusion, in patients with midfacial trauma and NLD fracture, epiphora occurred in 14.5% and endoscopic DCR was performed due to persistent epiphora in 5.5% and its results were all successful. These results can be of help in anticipating the potential for NLD obstruction after midfacial trauma and counseling facial trauma patients about potential future complications.

Author contributions

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