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Case report

High-resolution dacryoendoscopy for observation for pediatric lacrimal duct obstruction

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ABSTRACT

Purpose: The aim of this study was to describe high-resolution dacryoendoscopy findings for nasolacrimal duct obstruction (NLDO) in three representative pediatric cases with different etiologies.
Observations: In a case of congenital NLDO, a mucosal membranous obstruction was observed at the distal end of the nasolacrimal duct (NLD), and a slit-shaped opening of the NLD was observed after perforation. In a case of acquired NLDO secondary to an adenoviral infection, a membranous obstruction was observed at the proximal NLD. In a case of NLDO with chronic dacryocystitis in a patient with Down syndrome, diffuse fibrous obstruction was observed.
Conclusion and importance: High-resolution dacryoendoscopy enables a clearer visualization of pediatric lacrimal duct obstructions, leading to an improved understanding of their features.
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1. Introduction

Congenital nasolacrimal duct obstruction (CNLDO) is the most common cause of pediatric lacrimal duct obstruction [1]. The presence of the membrane covering the opening of the lacrimal duct is thought to cause CNLDO [2–4]. Some reports have described the use of dacryoendoscopy to observe abnormalities in patients with CNLDO [5–7]. However, dacryoendoscopic images have often been unclear because of technical limitations. High-resolution dacryoendoscope was launched for commercial use in Japan in 2013. The image quality that can be obtained has been significantly improved. Here, we report three representative cases of pediatric nasolacrimal duct obstruction (NLDO) with different causes, as observed using high-resolution dacryoendoscopy.

2. Material and method

All the subjects were treated at the Kanagawa Children's Medical Center, Yokohama City. Four hundred and forty-four children with lacrimal disease in a total of 584 eyes visited our institution between January 2011 and September 2015. A total of 217 eyes in 185 children who underwent lacrimal surgery during the study period were included. One hundred and forty-seven eyes in 131 children underwent office-based nasolacrimal duct probing. Office-based probing was performed in children with CNLDO between the ages of 6 and 12 months. The procedure was performed under topical anesthesia using a metal probe. Dacryocystorhinostomy (DCR) was performed for 1 eye, and other lacrimal surgery was performed for 14 eyes in 11 children. Dacryoendoscopic examinations and probing were performed in a total of 59 eyes in 46 children between the ages of 1 and 12 years old (mean 57.8 ± 55.0 months) during the study period. We obtained approval for this study from our Institutional Review Board. Informed consent was obtained from a guardian of each child.

We performed dacryoendoscopy under general anesthesia at a surgical facility using a commercial scope (RUIDO FT-203F MD10 [10000 elements]; FiberTech Co., Ltd., Tokyo, Japan). The scope consisted of a probe with an outer diameter of 0.9 mm (20-gauge) and a viewing angle of 60°. The images were displayed on a monitor. After the dilatation of the punctum, a dacryoendoscopic probe was inserted through the punctum into the lacrimal duct. Saline was injected through the water channel to obtain a better view.

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2.1. Findings

2.1.1. Case report 1

A 20-month-old girl with epiphora and mucopurulent discharge from her right eye since infancy visited for a consultation. She had never undergone either lacrimal duct probing or irrigation. She did not have either a systemic syndrome or a family history of lacrimal duct obstruction. A fluorescein disappearance test demonstrated a delayed clearance in the right eye. We diagnosed her as having CNLDO. A dacryocystography was performed under general anesthesia, and a position of obstruction located at the distal end of the nasolacrimal duct was identified (Fig. 1A).

Dacryoendoscopic images of the obstruction revealed an obstruction with a smooth and slightly concave surface that was slightly reddish and dark in color (Fig. 1B). We perforated the obstruction using the tip of the dacryoendoscope. Because the obstruction was membranous, it was relatively easy to perforate. After perforation, a slit-shaped opening in the nasolacrimal duct was visible (Fig. 1C and D).

2.1.2. Case report 2

A 9-year-old boy with epiphora and mucopurulent discharge from his right eye was seen as a consultation. His symptoms began after an epidemic keratoconjunctivitis (EKC) infection, which he experienced at the age of 4 years. The virus responsible for the keratoconjunctivitis had been confirmed using a SAS™ Adeno Test. He had never undergone either lacrimal duct probing or irrigation. A fluorescein disappearance test demonstrated a delayed clearance in the right eye. We diagnosed him as having acquired lacrimal duct obstruction secondary to an adenoviral infection. A dacryocystographic image showed an obstruction was located in the proximal nasolacrimal duct (NLD) (Fig. 2A). The dacryoendoscopic examination revealed a membranous obstruction that was slightly reddish and dark in color at the proximal NLD (Fig. 2B). We perforated the membranous obstruction using the tip of the dacryoendoscope. After perforation, a normal lumen in the nasolacrimal duct with multiple mucous folds was visible (Fig. 2C).

2.1.3. Case report 3

An 8-year-old boy with Down syndrome and epiphora and mucopurulent discharge from his right eye was seen as a consultation. His symptoms had started at the age of 4 years, without any trigger. He had not undergone either lacrimal duct probing or irrigation. A fluorescein disappearance test demonstrated a delayed clearance in the right eye. We diagnosed him as having primary acquired lacrimal duct obstruction with dacryocystitis. A dacryocystographic image showed a proximal nasolacrimal duct with a tapered appearance (Fig. 3A). The lacrimal duct was examined using a dacryoendoscope, and the lumen was found to be covered with white widespread fibrotic tissue (Fig. 3B). A dimple was present at the distal end of the obstruction (Fig. 3C). We perforated the dimple and attempted to remove the white fibrotic tissue but were unable to remove all the tissue (Fig. 3D). The diffuse fibrous obstruction was continued from the proximal end to the distal end of the nasolacrimal duct.

3. Discussion

High-resolution dacryoendoscopy allows a clearer visualization of the lumen of entire lacrimal drainage system, leading to an understanding of specific details of the pediatric lacrimal duct obstructions. This is the first report to describe the findings of pediatric lacrimal duct obstructions arising from diverse causes, as evaluated using a high-resolution dacryoendoscope. Dacryoendoscopy enabled successful and safe examinations of pediatric lacrimal duct obstruction in all the cases. The findings for typical CNLDO, as described above, were consistent with previous histological reports [3,4]. Findings revealing simple CNLDO were observed in 27 of the 59 eyes (46%) in our daryoendoscopic examination. In East Asia, acquired lacrimal duct obstruction in children is most commonly caused by EKC [8,9]. The location of membranous obstruction in patients with acquired lacrimal duct obstruction secondary to viral infection was revealed to be different from that of typical CNLDO. In children with Down syndrome, complicated lacrimal outflow abnormalities have been reported [10–13]. No observations of lacrimal ducts using dacryoendoscopy have been reported in this patient population. Widespread obstruction of the NLD is a rare finding in pediatric patients and may be caused by chronic inflammation.

The present study revealed that various types of lacrimal duct obstruction, other than typical CNLDO, are not uncommon in the pediatric population. Sasaki T. and colleagues classified primary NLDO in adults based on the site of obstruction, as evaluated using dacryoendoscopy [14]. They suggested that differences in the sites of obstruction may be related to differences in the etiologies. Dacryoendoscopy might be useful for understanding differences in the etiology of obstructions, leading to the selection of preferred surgical procedures based on the endoscopic findings. Previously reported studies showed that a significant percentage of pediatric DCR cases had an etiology other than typical CNLDO [15]. Our study revealed that dacryoendoscopy was very helpful for diagnosing the features of pediatric lacrimal duct obstruction, enabling the selection of patients with simple NLDO who could be treated with probing with or without the placement of a stent and the selection of other patients requiring DCR. Although an initial investment is necessary to perform dacryoendoscopy, specific disposable

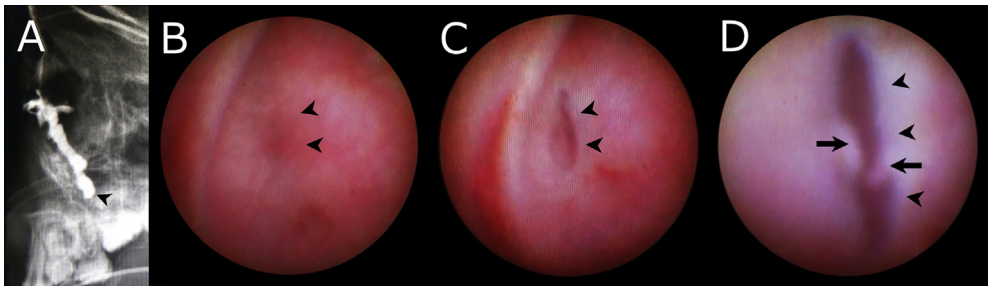

Fig. 1. Findings for a typical congenital nasolacrimal duct obstruction (Case1). **A**, Dacryocystographic image (lateral view). The obstruction was located at the distal end of the nasolacrimal duct (NLD) (arrowhead). **B,** Dacryoendoscopic image before perforation. A membranous obstruction that was dark in color (arrowhead) is visible. **C,** Dacryoendoscopic image obtained after perforation. An opening of the NLD is visible (arrowhead). **D**, Region located closer to the opening of the NLD. A slit-shaped opening of the NLD (arrowhead) with a torn membrane (arrow) is visible.

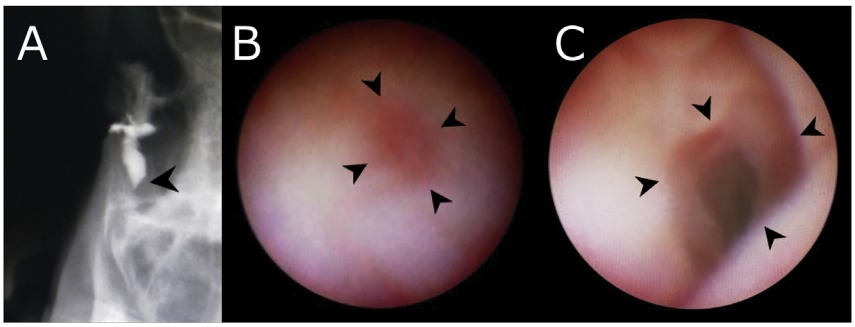

Fig. 2. Findings for a case of acquired NLDO caused by epidemic keratoconjunctivitis (Case 2). **A**, Dacryocystographic image (lateral view). The obstruction is located in the proximal NLD (arrowhead). **B,** Dacryoendoscopic image before perforation. A membranous obstruction with dark in color (arrowhead) is visible. **C,** Dacryoendoscopic image after perforation. A normal lumen in the NLD with multiple mucous folds is visible (arrowhead).

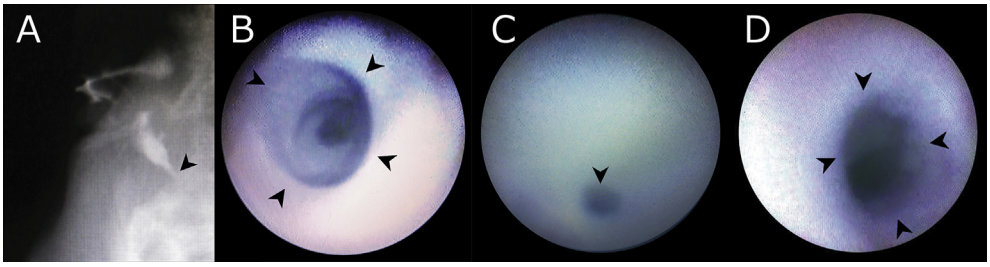

Fig. 3. Findings for a primary acquired lacrimal duct obstruction in a patient with dacryocystitis and Down syndrome (Case 3). **A**, Dacryocystographic image (lateral view). The obstruction is located in the proximal nasolacrimal duct (arrowhead). **B**, Dacryoendoscopic image of the obstruction site observed from the proximal side. Fibrous tissue gradually narrowing the nasolacrimal duct (arrowhead). **C**, Dacryoendoscopic image before perforation, located in the distal end of the obstruction. A dimple, representing the concave part of the fibrous obstruction, is visible (arrowhead). **D**, Dacryoendoscopic image after perforation. The inner wall is still coated with white fibrous tissue (arrowhead).

supplies are not required. Direct observation of the lacrimal lumen during probing is likely to enable greater precision, thus enabling, more successful and safer probing. Improving the success rate of probing and appropriate case selection for DCR should enable the overall, cost-effectiveness of this procedure to be realized.

Because the diameter of a dacryoendoscope is relatively small, the image quality is limited, even when a high-resolution endoscope is used. However, further improvements in instrumentation as technology progresses may enable more accurate examinations of the lacrimal duct lumen, and the further accumulation of cases is necessary.

4. Conclusions

High-resolution dacryoendoscopy enables a clearer visualization of pediatric lacrimal duct obstructions, leading to an improved understanding of their features. The dacryoendoscopy revealed that different etiologies of NLDO exhibit different visible pathologies.

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