

Utility of intraocular endoscope for lacrimal canaliculi and sac examination

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Abstract

Purpose Intraocular endoscope was used as a dacry-
oendoscope, and its observations and performance in
lacrimal drainage system (LDS) are reported.

Methods The Endo Optiks (Little Silver, New
Jersey, USA), an intraocular endoscope (modified
with customized sheath), was used for LDS visualiza-
tion in ten normal adults and five patients with
lacrimal disorders.

Results We were able to capture high-definition
images of lacrimal canaliculi and sac in all normal
adults. Smooth whitish canalicular mucosa with lumen
could be appreciated in all normal individuals. Com-
mon canaliculus showed variable folds among indi-
viduals and reddish lacrimal sac mucosa could be
appreciated with great details. In patients with
canalicular obstruction, site of obstruction was pre-
sented as whitish gray area with no visible lumen,
which could be opened up precisely with trephination.
No false passage was formed in any of the cases. One
of the cases had membranous canalicular obstruction,
which was opened with probe itself. Nasolacrimal duct
could not be examined due to the shorter length of the
probe.

Conclusion Intraocular endoscope can be used as
high-resolution dacryoendoscope for visualization of
lacrimal canaliculi and sac.

Keywords Dacryoendoscope · Endoptiks · Lacrimal
sac · Lacrimal canaliculi

Introduction

Dacryoendoscopy is the microendoscopy of lacrimal
system, which allows direct access to canaliculi,
common canaliculus, lacrimal sac and nasolacrimal
duct (NLD) [1, 2]. It has paved a way for the better
understanding of canalicular pathologies like stenosis,
obstructions, granulomas, thereby facilitating their
management [3–7]. Apart from its diagnostic role, the
dacryoendoscope has also been employed in under-
standing the physiology of lacrimal drainage system
(LDS) [8]. Its first use was published in 1992 for the
diagnostic evaluation of patients planned for lacrimal
intervention [1]. Currently available dacryoendo-
scopes are A 0.6-mm microendoscope (Karl Storz,
Tuttlingen, Germany) modified from the original
sialoendoscope, and a high-definition dacryoendo-
scope (HDD; FiberTech, Japan) is available in straight
or curved tips with diameters varying from 0.7 to
0.9 mm.

Recently, the use of intraocular endoscope has
shown tremendous increase in the management of

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refractory glaucomas, diagnostic endoscopy and performing endoscopic vitrectomy [9]. We have modified the probe by adding an irrigation port to it and explored its utility in lacrimal drainage system among normal and diseased states. In this paper, we report our findings of lacrimal system imaging using an intraocular endoscope.

Instrumentation

The Endo Optiks (Little Silver, New Jersey, USA) is an intraocular endoscope designed for endoscopic vitrectomy, endocyclophotocoagulation and diagnostic evaluation of posterior segment. It has a control unit (box) containing a xenon light source, a charge-coupled device (CCD) camera, which captures the image from the fiberoptic and projects it on a monitor, and an 810-nm laser. The endoscope probe (0°) comes in three different sizes: 19 gauge (1 mm; 17 000 pixels), 20 gauge (0.9 mm; 10 000 pixels) and 23 gauge (0.6 mm; 6000 pixels; Fig. 1a, b). Illumination and viewing are coaxial with endoscopy, so light reflection off the ocular tissues needs probe adjustment. We customized the irrigation channel using 22G intravenous catheter sheath introduced over the 23G probe (Fig. 1c). A small nick with 15 no. blade was made at the proximal end and probe was carefully inserted into the sheath. Customized irrigation sheath (outer diameter = 0.7 mm) was added to wash off the debris/secretions across the drainage pathways. Dacryoendoscopic images were recorded with a video recorder (Sony HVO-550MD;), and individual images

were subsequently extracted from the video file for analysis.

Technique

A single observer (SS), oculoplastic surgeon has performed dacryoendoscopy in all cases. We selected 10 normal adult healthy volunteers with no epiphora and patent irrigation who provided consent for dacryoendoscopy. Patients' data where dacryoendoscopy was performed using Endoptiks in past 3 months were included. A local anesthetic drop (0.1% proparacaine) was instilled into the conjunctival cul-de-sac followed by punctum dilatation with punctum dilator. The 23G endoscope probe was inserted through the upper canaliculus in normal individuals (10), and through the involved canaliculi in diseased cases (5). We tried using the 20G probe as well in the normal cases but it required forceful dilatation of the punctum, which was painful without any local anesthesia. Hence, we used the 23G endoscope with saline insufflation (outer diameter = 0.7 mm) in normal volunteers. Alternatively, the 20G probe was also used in five patients as local anesthesia was administered for the intended procedure. Saline was injected through the water channel to obtain a better view whenever needed (Fig. 1c). Retracting and advancing the endoscope gives a good overview for beginners and helps in avoiding mucosal injury. Scattering of light due to coaxial illumination could be resolved with constant probe and light adjustment across different areas.

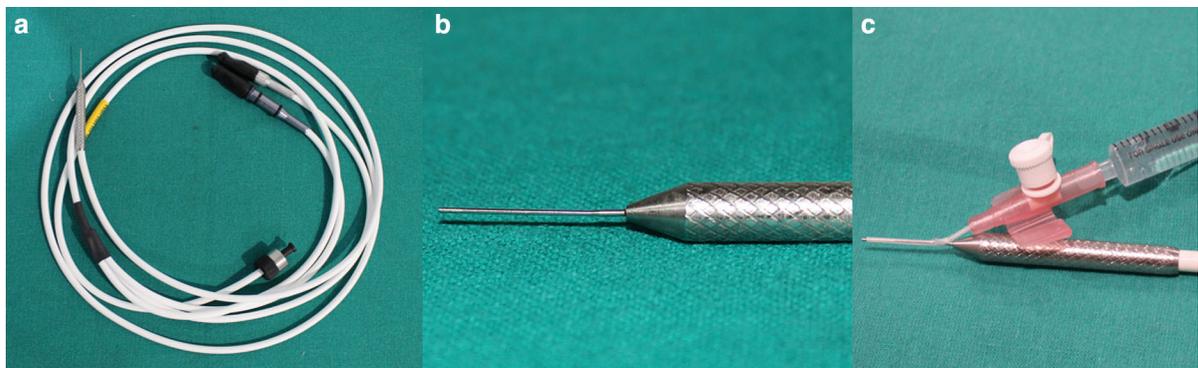


Fig. 1 a 23G endoptiks probe along with fiberoptic cable. b Close view of 22-mm-long probe and its tip. c Customized sheath with irrigation channel (marked with arrow)

Results

In diseased cases, epiphora was due to canalicular obstruction in four patients and stent migration due to post-monocanalicular intubation in one patient. We were able to capture high-definition images of lacrimal canaliculi and sac in all cases. We could not image the NLD due to shorter length of the probe. Picture quality, depth of focus and axial illumination were comparable to the reported images captured using HDD (Fig. 2a, b). All patients who had been examined described the experience of endoscopy as not being painful and comparable to lacrimal irrigation.

Normal

Canalicular mucosa appeared whitish and smooth with visible folds in few cases (6/10). Its lumen narrowed progressively on moving toward the lacrimal sac. Common canaliculus showed a narrower lumen with prominent mucosal folds varying in location (Fig. 2c). An incidental papilloma was noted at the common canaliculus in one of the normal cases (Fig. 2d). The lumen widened as we entered the lacrimal sac, which had pinkish mucosa and occasionally visible vascular channels (Fig. 2e). Floating mucus secretions in a layer of meniscus overlying the lacrimal sac walls could be seen in most of the cases. Irrigation helped in

Fig. 2 **a** and **b** Canalicular cavity with visible folds at common canalicular (CC) area. **c** Common canaliculus can be seen with inferior fold, and mucoid debris. **d** Incidental finding of papilloma at CC area in an otherwise asymptomatic normal individual. **e** Lacrimal sac with mucosal folds in the lateral wall. **f** Obliterated lumen with whitish gray appearance of obstructed area in canalicular obstruction

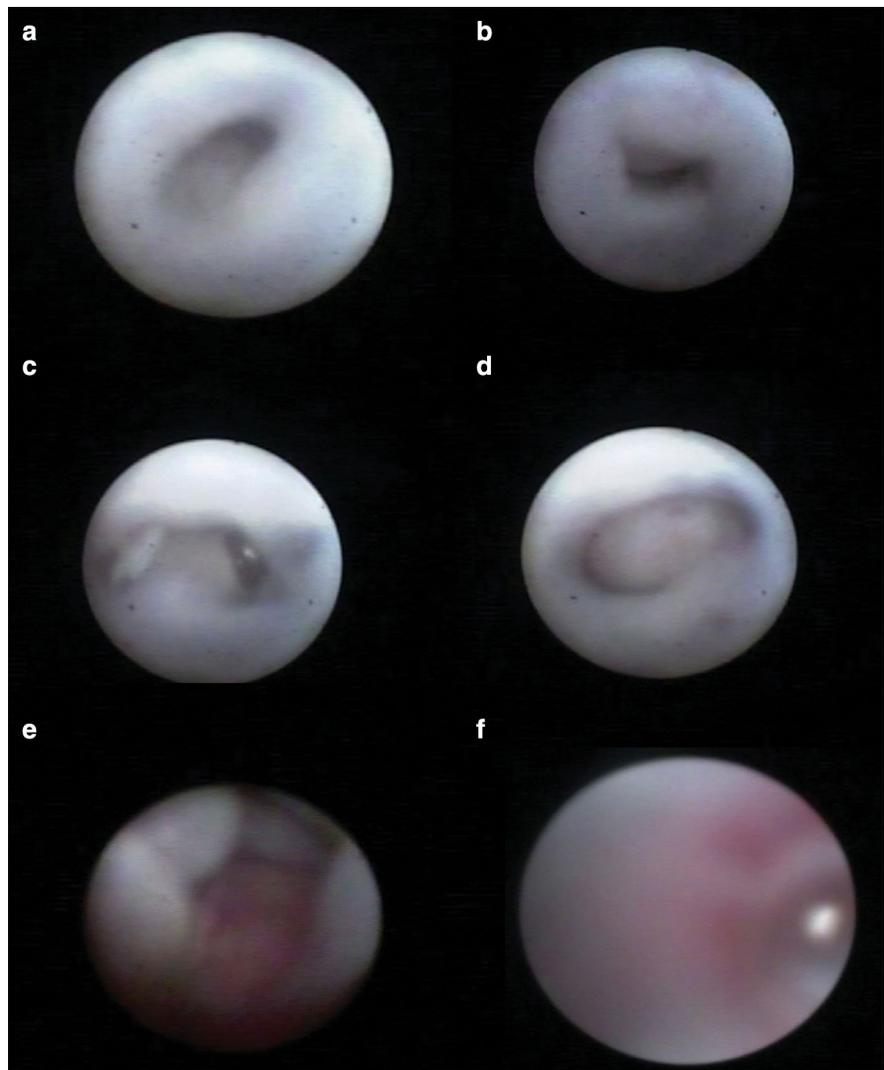
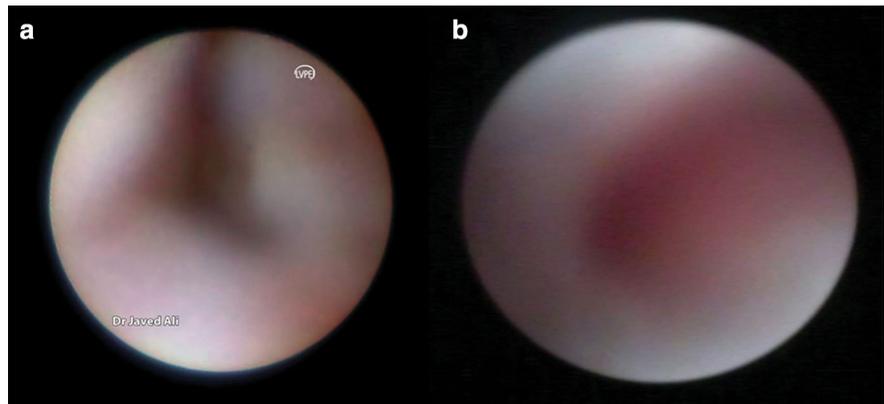


Fig. 3 **a** Representative image of normal canaliculus captured with Fibertech dacryoendoscope probe (0.9 mm). **b** Normal canaliculus with reddish hue of blood visible in lumen (Endoptiks, probe 0.9 mm)



differentiating the debris from stenosis (debris got washed off).

Diseased states

The site of obstruction could be precisely located in four cases with canalicular obstruction. The obstructed area presented as whitish gray with lumen obscuration in the canaliculus (Fig. 2f). All cases had successful canalicular trephination without any false passage formation and were intubated with monocanicular intubation. One of the cases had membranous canalicular obstruction, which could be opened with the probe itself. Migrated monocanicular stent (1) was found impacted in the mid-canalculus as a whitish rod-like structure, which was removed carefully with nasal endoscopy. No complications such as perforation, postoperative bleeding or inflammation occurred during any of the endoscopic examinations.

Discussion

Dacryoendoscopes have enabled the treatment of canalicular papillomas, removal of migrated punctal plugs, dacryoliths removal and recanalization of NLD possible with gratifying results especially in pediatric NLD obstruction [3, 4, 7, 10, 11]. The dacryoendoscope definitely outweighs the existing imaging techniques like UBM and OCT which provide only cross-sectional images at one point and lack mucosal high-definition images. The advantage of endoscopic examination is direct visualization and precise

localization of the stenosis or obstruction in the LDS. The appropriate decision about a surgical procedure then can be taken. Moreover, dacryoendoscopy-guided management avoids complications that arise with blind procedure.

Endoscopy of the lacrimal system was explored in 1992 in an experimental study using ultrathin 0.5-mm fiberscopes in cadaveric lacrimal system [8]. It has undergone several modifications thereafter with the aim of achieving a better picture quality. A 0.6-mm microendoscope (Karl Storz, Tuttlingen, Germany) modified from the original sialoendoscope is also commercially available. It is available as a 0° straight telescope (10,000 pixels; 0.65–0.85 mm outside diameter) with an irrigation port and provides 110° field view. FiberTech, Japan recently introduced a HDD specifically designed for the lacrimal system. Its camera consists of 15,000 picture elements and available in different sizes: 1.1, 0.9-mm straight and curved tips. These microendoscopes are costly and can be used only for lacrimal system visualization. On the other hand, Endoptiks setup is being used in other ophthalmic specialities as well like glaucoma and vitreoretinal surgeries. It has a camera with slightly lesser pixels (10,000 in 0.9-mm-sized probe) as available in HDD (Fibertech; 15,000 in 0.9 mm). Its use in LDS has been described for the first time in the current study. Normally visible canalicular and sac mucosal folds could be seen clearly. In obstructed systems, the site of obstruction appeared similar to the findings described with HDD. In one case, membranous obstruction in canaliculi was opened up with probe itself and rest of the lacrimal canaliculi and sac was normal on dacryoendoscopic examination. We

have customized the sleeve for covering the probe using a 22G intravenous cannula. The sheath is supposed to deliver irrigation at the desired site, which clears away the air bubbles and debris. This sheath could be utilized with the 23G probe but not with the 20G since outer diameter increased to 1.2 mm with the 20G. We recommend the 20G probe to be used for any intervention planned in cases with canalicular obstruction since local anesthesia will already be employed. Sasaki et al. [2] have tried new, custom-made, air-insufflated HDD in LDS disorders and found image quality to be superior to the conventional dacryocystoscopy. Further exploration of these differences between saline and air insufflation can be tried with intraocular endoscopes as well.

Endoscopy can be safely performed in an outpatient setting without adverse effects. Ophthalmic setups with available endoscopic vitrectomy can use their probes for LDS evaluation as well. It saves the additional expense of buying a dacryocystoscope for the lacrimal evaluation. Figure 3 shows the representative image of lacrimal sac captured with FiberTech HDD and intraocular endoscope in different patients. We did not have HDD (FiberTech) at our center for direct comparison. We do not claim that it can replace the HDD ones but can be used at centers with existing Endoptiks system. Also, longer-sized probes are needed for NLD visualization. Intraocular endoscopes can be used as a high-resolution dacryocystoscopes for visualization of lacrimal canaliculi and sac. Further modifications/studies will help in making this system better.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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