



# Preliminary experience with exoscope in lacrimal surgery

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Received: 2 May 2020 / Accepted: 15 September 2020  
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## Abstract

**Background** Endoscopic dacryocystorhinostomy (e-DCR) is the mainstay for lacrimal sac/duct conditions. The purpose is to investigate the role of the exoscope as assisting tool in e-DCR.

**Methods** Primary endpoint were symptoms resolution (epiphora/dacryocystitis) and time for surgery. Qualitative features of the exoscope were analyzed: a questionnaire administered to the surgical team allowed to evaluate the perceived quality of this technology.

**Conclusions** The exoscope is a new tool that may support e-DCR. It has comparable results on symptoms outcomes and time for surgery than classic e-DCR. This new technology was accepted by all team members and showed great teaching potential.

**Keywords** Teaching · Endoscopic dacryocystorhinostomy · New technology in lacrimal surgery · Exoscope · Image magnification

## Introduction

Endoscopic dacryocystorhinostomy (e-DCR) is a well proven technique for cases of nasolacrimal duct obstruction (NLDO) [1, 2]. It established its significance as a comparable technique to external DCR (ex-DCR) in terms of controlling lacrimal sac infections (dacryocystitis) and epiphora. Compared to the ex-DCR, e-DCR has multiple advantages: it avoids the risk of cutaneous scarring, it has lower infection rates and the potential of prompt intervention in cases of mucopyocele [3, 4]. Some studies showed its superior results to ex-DCR in control of the epiphora because of sparing Jones lacrimal pump [4, 5]. In e-DCR, greater precision and bone preservation of the lateral nasal wall are allowed, as well as correction of anatomical variants in cases of concurrent sinonasal pathology [3]. In our experience in the Dept

of ENT-HNS at Humanitas Research Hospital, we preliminarily studied the applicability of the exoscopic technology to DCR procedures, evaluating surgical outcomes, time for surgery, team members' self-perception. The combined exo-endoscopic view was also compared to endoscopy alone.

## Relevant surgical anatomy

The anatomy of the lateral nasal wall should be known and accurately studied in each case by means of thin-section CT scan, especially the projection of the uncinat process (UP) and the presence of endonasal anatomical variants.

## Description of the technique

The exoscope (VITOM<sup>®</sup> 2D/3D by Karl Storz, Tuttlingen, Germany) is a compact video microscope sustained by a specific holder, placed upon the surgical field at a 20–50 cm distance and displaying images on a flat screen. It's provided with digital zooming and an enlarging power up to 8–30 times. In the exo-endoscopic approach applied in this study, the exoscopic camera was used combined with an endoscope thanks to the Picture-in-Picture (PiP) display modality, which consists of a split screen with simultaneous picturing of both the outer ocular field (for the ophthalmologist) and the nasal cavity (Figs. 1, 2). All patients in the study underwent DCR according to the technique described in literature,

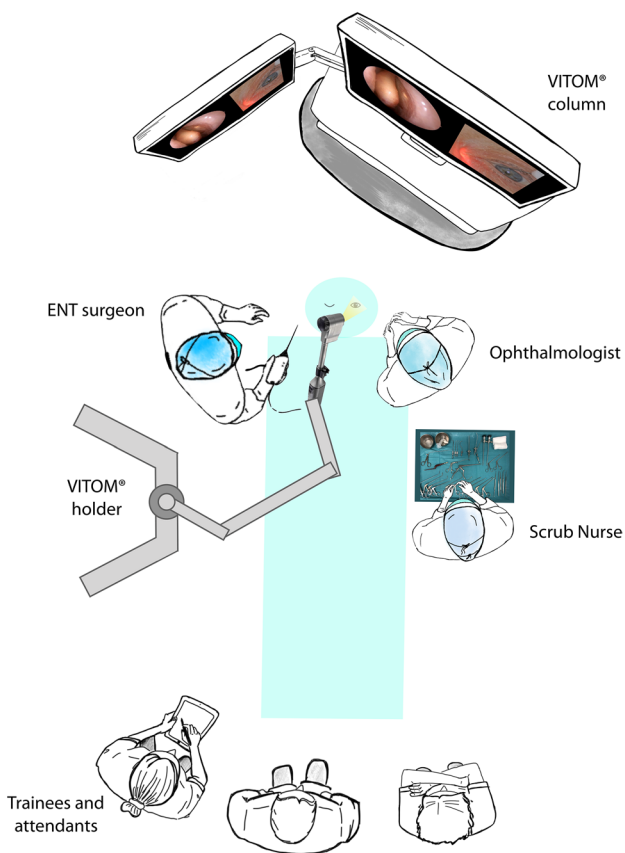
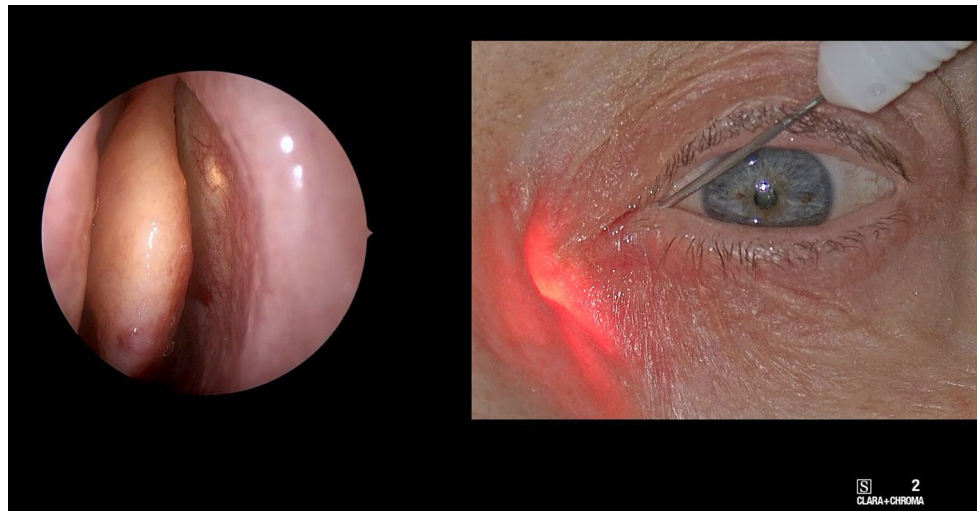
**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s00405-020-06379-9>) contains supplementary material, which is available to authorized users.

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**Fig. 1** Picture-in-picture (PiP) display view. On the left, the ENT endoscopic view; on the right, the ophthalmologist exoscopic view, with magnification of the eye and lacrimal punctae



**Fig. 2** Positioning of VITOM® exoscope holder and column (with computer and recording unit) in the operating room

via posterior lacrimal sac approach [1, 5–7]. Recordings of all procedures were taken thanks to VITOM®'s integrated control unit. With the posterior approach, the lacrimal sac is opened at the level of the lacrimal bone. After decongestion, retrograde uncinectomy and removal of the vertical portion of the UP give access to the lacrimal bone.

The Ophthalmologist introduces a light probe through the inferior lacrimal canaliculus, projecting light onto the lateral nasal wall (Fig. 1). The point of greatest luminescence corresponds to the thinnest bone (i.e. the lacrimal bone): with a diamond bur the area is drilled till the lacrimal sac is exposed. Residual bone fragments are removed. The lacrimal sac is medialized with the light probe and the sac is incised and marsupialized. The lacrimal pathway is repeatedly washed with saline solution, then lacrimal intubation with a silicone stent (tied inside the nasal fossa) completes the procedure. The entire procedure is performed by looking at the PiP screen. The ENT and Ophthalmologist's simultaneous view of the surgical field allows them to operate synchronously, and without moving their head from their natural operating position, as the other surgeon's procedure is quickly visible at a glance on the screen (Figs. 1, 2).

## Indications

Indications to surgery are recurrent dacryocystitis, continuous epiphora despite probing/irrigation, epiphora with mucopurulent discharge. Patients whose symptoms are caused by conditions of the eyelid (e.g. floppy eyelid syndrome) or the canaliculi should not undergo e-DCR. A CT scan with contrast dye should be conducted in all patients for mapping nasolacrimal anatomy; once the obstruction is demonstrated at the level of the lacrimal sac or duct, patients are amenable to DCR.

## Limitations

Larger space may be needed to comfortably place the equipment. Moreover, finding the correct distance between the surgeons and the video tower, for the best visual conditions and the least eye strain, is initially difficult. Yet, these drawbacks are likely managed with time and experience. The

machinery (VITOM<sup>®</sup> exoscope, holder, video-tower) is not worth its high cost if purchased only for nasal surgery. However, it is widely shared with other scenarios in ENT-HN surgery (e.g. otosurgery, laryngeal microsurgery, and microvascular anastomosis in reconstructive surgery) [8] and with other specialties inside the hospital [9, 10] (e.g. neurosurgery, vascular surgery). In this case, its cost is largely amortisable.

### How to avoid complications

No further complications were noted compared to classic e-DCR. The noticeable added value of the exoscope is the PiP view of both the internal and external structures: it can help avoiding intraoperative complication as false paths, especially for less experienced surgeons, because the simultaneous view allows greater precision in lacrimal intubation and superior control of the probe direction.

### Perioperative considerations

Each patient should be examined by an ophthalmologist (assessment of lacrimal punctae and medial canthal region) and an ENT surgeon (degree of nasal obstruction and presence of anatomical variants). In our experience all patients were evaluated at 7, 14, 30 days after surgery, in some cases for longer time, and success (resolution of epiphora/dacryocystitis) was assessed after 6 months. In this study, the exo-endoscopic view was endorsed by ENTs, however issues were initially reported by Ophthalmologists (who exposed criticism to visual features such as reduced stereoscopic effect and increased eye strain due to watching a screen). Most of the visual issues later improved, hence we hypothesised it was because of the unfamiliarity of Ophthalmologists with indirect-vision surgery that uses video monitors. Indeed, it improved over time as more procedures were performed. The possibility of sharing the same view of the surgeons with the PiP view was greatly appreciated by the team and trainees, who commented that their visualization of the operations significantly upgraded, increasing understanding of procedures and enhancing teaching environment. Surgeons can explain phases of the procedures just by referring to what is visible on the screen by anybody in the operating room or in network connection. Also, footages can be always used for later teaching or reviewing critical steps to prepare for future operations.

### Information to patients

Information to patients do not differ from that given for e-DCR.

### Summary

1. Endoscopic DCR is the mainstay for NLDO and has advantages compared to the ab externo DCR.
2. Pre-operative study should be performed with dacryocystography, ophthalmological exam and nasal endoscopy.
3. The indications for exo-endoscopic DCR are the same as for classic e-DCR.
4. The exoscope is a full-HD camera placed on the surgical field, pointing and lighting the outer ocular region.
5. The PiP view of the exo-endoscopic approach allows all members of the operative team to have the same visual inputs as the surgeons.
6. The machinery (VITOM<sup>®</sup> exoscope, holder, video-tower) is relatively expensive but it can be shared with other specialties (neurosurgery, vascular surgery) or other types of ENT surgery, thus its cost is overall amortizable.
7. Frequent post-op examinations are required to check lacrimal re-stenosis and evaluate prompt re-intervention.
8. Combined exo-endoscopic DCR is safe and effective, as no complications were observed, success rate was comparable to classic e-DCR and operative time was acceptable.
9. A subjective good perception was acknowledged by the involved surgeons, nurses, trainees and attendants.
10. Better teaching experience is possible both in the operative room, in network connection or later, as all surgical actions are visible on recordings in PiP view.

**Funding** No financial support or benefits were received by any authors.

### Compliance with ethical standards

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

**Ethical approval** Ethical approval was waived by the local Ethics Committee of Humanitas Clinical and Research Hospital in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

**Informed consent** Informed consent was obtained from all individual participants included in the study and all of them signed informed consent regarding publishing their data and photographs. Additional informed consent was obtained from participant for whom possible

identifying information is included in this article (Fig. 1). A copy of the consent form is available for review by the Editor of this journal.

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