

Endoscopic transnasal canaliculorhinostomy for refractory common canalicular obstruction with an unidentifiable lacrimal sac

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Abstract

• **AIM:** To describe the role of endoscopic transnasal canaliculorhinostomy (ETC) in refractory common canalicular obstruction (CCO) associated with an absent or unidentifiable lacrimal sac.

• **METHODS:** The records of patients with refractory CCO who underwent ETC at the Eye Hospital of Wenzhou Medical University from October 2007 to December 2016 were retrospectively reviewed.

• **RESULTS:** Fifty-six patients (56 eyes) with refractory CCO were recruited into the study. Eight patients were excluded due to the presence of a residual lacrimal sac or failure to complete the follow-up duration. The anatomic and functional success rates were both 85.4% (41/48) at a mean follow-up of 18.6mo. Five cases failed as a result of ostial synechia and two failed because of ostial obstruction by granulation. Postoperative complications included mild nasal bleeding in 5 cases, dried nasal feeling in 8 cases, and olfactory dysfunction in 4 cases.

• **CONCLUSION:** Although being surgically challenging, ETC has comparable findings to its external approach

counterpart or conjunctivodacryocystorhinostomy (CDCR) with Jones tube. And it may prove to be a novel alternate surgical technique for patients with refractory CCO without identifiable lacrimal sac.

• **KEYWORDS:** refractory common canalicular obstruction; endoscopic transnasal canaliculorhinostomy; lacrimal reconstructive surgery

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INTRODUCTION

Common canalicular obstruction (CCO) is a common yet challenging lacrimal disorder. Various surgical techniques to treat CCO such as lacrimal probing, canalicular trephination, laser canaliculoplasty, balloon canaliculoplasty, or dacryocystorhinostomy (DCR) combined with bicanalicular silicone intubation have been described^[1-6]. However, recurrence of symptoms following treatment is common. In cases where the lacrimal sac is normal or enlarged, excising the obstructed portion and suturing the remained caliculus with lacrimal sac, or performing an internal membranectomy of the obstructed common canaliculus in combination with DCR and bicanalicular silicone intubation, or conjunctivodacryocystorhinostomy (CDCR) with Jone's tube intubation are recommended^[4-12]. When the lacrimal sac is unable to be identified due to reasons like trauma, atrophy by chronic dacryocystitis, previous dacryocystectomy, prior failed DCR, or tumor removal involving lacrimal sac, CDCR with Jone's tube intubation is recommended and even considered as the gold standard treatment^[5,13-18]. Although a high anatomic success rate has been reported with these procedures, permanent prosthesis, long-term follow-up and high frequency of complications limit its use^[5,13-18]. Recently, with Jone's tube intubation, canaliculorhinostomy surgery *via* an approach

similar to external DCR was reported to be an alternative treatment^[5-6,19-22], whereas it is still less popular mainly due to uncertain results, technical difficulty and disadvantages of external DCR.

With the advance of modern endoscopic techniques, endoscopic lacrimal surgery has evolved rapidly thanks to its minimally invasive nature. In this study, we aim to describe the utilization of endoscopic lacrimal surgery in these challenging refractory cases.

SUBJECTS AND METHODS

Ethical Approval Ethics approval was obtained from the Institutional Review Board and the study was conducted in accordance with the tenets of the Declaration of Helsinki.

A retrospective, non-comparative interventional study was performed. The medical records of patients who underwent a common canaliculorhinostomy *via* an endoscopic transnasal approach at the Eye Hospital of Wenzhou Medical University from October 2007 to December 2016 were retrospectively reviewed.

Clinical records were reviewed including patient demographics, previous medical and surgical history as well as clinical information such as preoperative clinical symptoms, lacrimal probing and syringing findings, the underlying etiology and location of lacrimal obstruction, preoperative computerized tomography (CT) findings, postoperative anatomical, and functional success.

Subjects All patients included were over the age of 18y. Refractory cases were defined as unrelieved or recurrent CCO previously treated by lacrimal probing or laser canaliculoplasty combined with bicanicular silicone intubation. The diagnosis of CCO was made on the basis of a history of significant epiphora without purulent discharge or regurgitation on pressure over lacrimal sac. This was further confirmed by lacrimal irrigation with no reflux or only clear fluid from the opposite punctum associated with obstruction during diagnostic lacrimal probing at more than 12 mm from the punctum. All patients also demonstrated an absent or unidentifiable lacrimal sac, caused by trauma, previous dacryocystectomy, or failed prior DCR on preoperative computerized tomographic dacryocystography. Exclusion criteria included patients with eyelid malposition (ectropion or entropion), previous facial fractures, nasal diseases such as polyps and chronic rhinosinusitis, previous history of physical scars and bleeding diathesis, lacrimal obstruction at multiple levels or history of lacrimal surgery.

Surgical Technique of Endoscopic Transnasal Canaliculorhinostomy All surgeries were performed by one surgeon (Wu WC). A non-laser conventional endoscopic transnasal DCR was performed under local anesthesia as described in previous studies^[23-25]. A mixture of 2 mL of

2% lidocaine and epinephrine (1:100 000) was injected into the lateral nasal mucosa in addition to an external anterior ethmoidal nerve block and an infraorbital nerve block. Under direct visualization with a 45° 4-mm endonasal endoscope (Karl Storz, Tuttlingen, Germany), the lateral nasal mucosa was incised in the area of the lacrimal sac fossa and folded onto the middle meatus. Using a 15° diamond burr attached to a microdebrider (IPC, Medtronic Xomed, Minneapolis, MN, USA) and/or a Hajek-Koffler forward-biting punch, a large osteotomy of approximately 10×12 mm² in size was created to expose the region of the lacrimal sac. A Bowman probe was then inserted from the canaliculus to determine the length of the remaining patent canaliculus as well as the site and status of the lacrimal sac (Figure 1A). If the lacrimal sac could be identified, a canaliculo-DCR was performed. Otherwise, the agger nasi cells were opened, and the thick frontal process of maxilla was further drilled to expose the upper part of the lacrimal sac and common canaliculus. The region of the lacrimal sac was then carefully incised (Figure 1B) and the status of the lacrimal sac was reassessed. Following that, the common canaliculus was tented using an inserted Bowman probe from the canaliculus (Figure 1C and 1D) and carefully incised vertically with a small sharp sickle knife (Figure 2A) to carefully form a little posteromedial canalicular flap (Figure 2B and 2C). The canalicular flap was then flattened medially, posteriorly or inferiorly to create an ‘adequately sized’ ostium (Figure 2D).

A MeroGel (Medtronic Xomed Surgical Products, Jacksonville, FL, USA) sheet was then trimmed to numerous sizable pieces to line the surrounding surface of the common canalicular ostium as described in our previous papers (Figure 3A)^[24,26]. If possible, a piece of nasal mucosa was isolated from the front border of the ethmoidal uncinat process and trimmed to an appropriate size to cover the raw bone surface of the upper frontal process of maxilla and the surrounding wound surface of the osteoma, ensuring edge contact between the posterior common canalicular flap and nasal mucosa. Pieces of MeroGel were then used to cover the flattened posterior medial common canalicular flap and the wound surface around the ostium (Figure 3B and 3C). For better tear flow, healing and epithelialization of the canalicular ostium, to ensure its patency, no canalicular intubation was performed in this procedure.

Postoperative Care and Follow-up All patients were admitted for observation and antibiotics for 3d following surgery. A course of local antibiotic and anti-inflammatory drops was administered for 2wk, along with intranasal steroid spray three times daily (Rhinocort Aqua, AstraZeneca, Wilmington, DE, USA). Follow-up was scheduled weekly for the first 2wk, then monthly for the following 2mo, and then every 2-3mo for the next 9mo. At each review, regular nasal

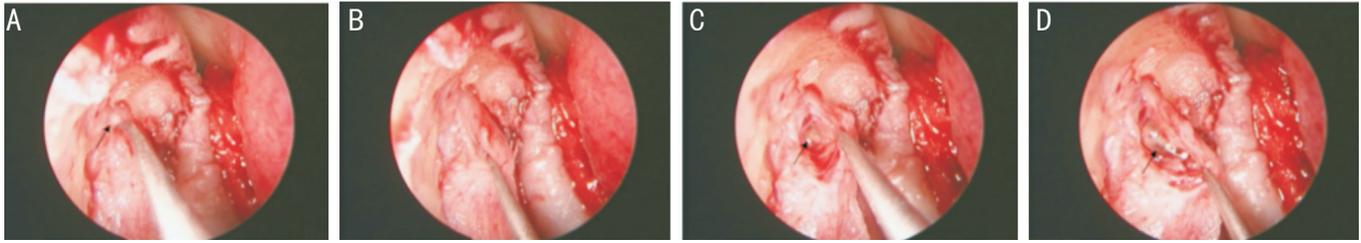


Figure 1 Localizing the common canaliculus during endoscopic transnasal common canaliculorhinostomy A: Bowman probe (arrow) inserted from canaliculus to determine the site and status of the lacrimal sac; B: Region of lacrimal sac being carefully excised; C: Tip of Bowman probe (arrow) seen at site of common canaliculus; D: Bowman probe (arrow) advanced further to tent the obstructed common canaliculus.

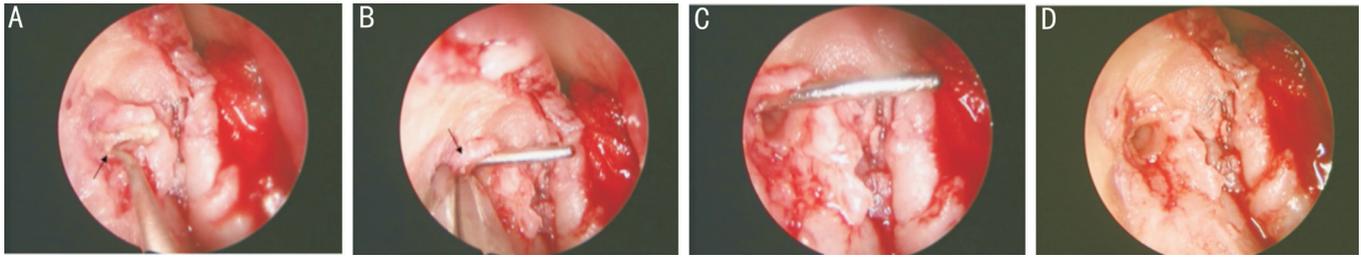


Figure 2 Careful preparation of the canicular flap for adequate sized ostium during surgery A: Vertical incision performed over the common canaliculus with a sickle knife (arrow); B: Superoanterior aspect of flap (arrow) cut with scissors to mobilize flap posteriorly; C: Posteromedial canicular flap being flattened posteriorly with Bowman probe; D: Adequately sized ostium seen after canicular flap flattened posteriorly.

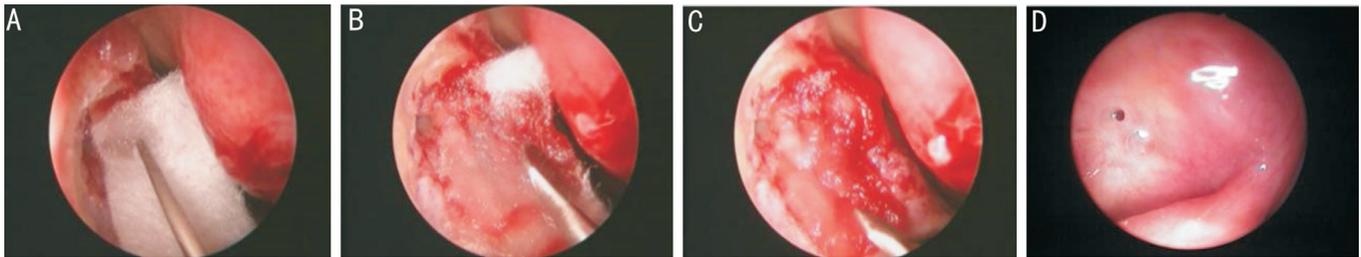


Figure 3 MeroGel lining the wound surfaces around the ostium A: MeroGel sheet was trimmed to sizeable pieces to line the surrounding surfaces of the common canicular ostium; B: Trimmed MeroGel sheet was used to cover the flattened posteromedial common canicular flap; C: Wound surface around the ostium was lined with MeroGel; D: Ostium was seen to be patent and surrounded by healthy epithelial mucosa at 1y follow-up.

endoscopic examination was carried out to assess the degree of wound healing, the status of mucosa epithelialization and the presence of scarring or/and granulation around the ostium within 1-2 mm range. Symptoms such as epiphora and purulent discharge were recorded. Nasolacrimal irrigation and fluorescein dye disappearance test (FDDT) was also performed.

Definition of Success Rate Anatomic success was defined as the presence of a patent neo-ostium surrounded by 1-2 mm healthy epithelialized mucosa during endoscopic examination and a patent lacrimal system on syringing. Functional success was defined as complete resolution of epiphora and normal FDDT. Cases experiencing minimal or no improvement in the epiphora were deemed to failure.

RESULTS

A total of 56 consecutive patients with refractory CCO were

included from October 2007 to December 2016. Forty-eight patients were recruited and 8 patients were excluded. Three of them still had a very small residual lacrimal sac detected by the endoscope. Five patients failed to complete the follow-up. Of the 48 eyes of 48 patients, 15 were male and 33 were female, with an average age of 46.7 ± 13.3 (range 20-73)y. Twenty-five right eyes and 23 left eyes were involved, with a mean symptomatic duration of 19.1 ± 8.0 (range 9-48)mo. The mean postoperative follow-up duration was 18.6 ± 6.1 (range 12 to 36)mo. The most common cause of absent or undetectable lacrimal sac was previous DCR ($n=19$), followed by trauma ($n=16$), long-standing atrophic chronic dacryocystitis ($n=8$), and previous dacryocystectomy ($n=5$). Under the endoscope, 37 of 48 cases were found to be dense fibrosis with different thickness near the distal end of the common canaliculus.

We found that MeroGel was mostly absorbed within 2-3wk following surgery. At 2-week review, all patients had a healed patent ostium with a lining of intact epithelial mucosa. At the final review, the ostium was surrounded by healthy epithelial mucosa in 41 patients (Figure 3D). The anatomic success rate was 85.4% (41/48), the same as that of functional rate. At the final review, although most patients had variable degrees of fibrosis proliferation present within 4-5 mm of the ostium, the ostium remained patent in 41 patients. Complete ostial closure due to scarring was seen in 5 patients while 2 patients had granulation tissue obstructing the ostia. All the 7 failed patients denied further treatment. The postoperative complications were observed in 14 cases, including mild epistaxis ($n=5$), nasal discomfort and dryness ($n=8$), and olfactory dysfunction ($n=4$).

DISCUSSION

To date, various modalities such as direct anastomosis of the remaining patent canaliculus to the lacrimal sac and canaliculo-DCR have been applied to manage refractory CCO with normal lacrimal sac with satisfactory outcomes^[1-12]. However, literature on the management of refractory CCO with an undetectable lacrimal sac seen in this case series is very limited. In most cases, performing a CDCR with a Jones tube insertion is usually the only option^[14].

Our study showed that over 85% of our patients had their physiological tear drainage restored. This is comparable to that of a primary CDCR with Jones tube insertion. Its success rate has been reported between 14.0% and 83.9%. With modifications of the Jones tube and improvements of its implant techniques, the anatomic success rate can be increased to 100%^[13-18,27]. However, its functional success rate ranged from 57.0% to 100%^[13-18]. Many studies have also demonstrated high rates of tube problems with the use of a Jones tube, including tube dysfunction, obstruction, displacement, infection, bleeding, and ocular surface irritation, as well as poor patient satisfaction, with up to 46.7% of patients being unsatisfied^[13-18,27].

Theoretically, for refractory CCO with an unidentifiable lacrimal sac, resecting the obstructed segment and then connecting the remained patent canaliculus to nasal mucosa, namely canaliculorhinostomy is more anatomically in line with the normal mechanism of tear drainage. However, this procedure has rarely been reported and its low popularity may ascribe to its technical difficulty as well as its uncertain outcome. This surgical procedure was once mentioned by Rycoff^[22] in 1951, but no details on the surgical outcome was provided. Doucet and Hurwitz^[20] previously described the use of canaliculorhinostomy to reconstruct the lacrimal system in case series of 30 failed lacrimal surgeries. They reported a functional success rate of more than two thirds

with a minimum follow-up of 9mo. Using this technique to deal with CCO with no or undetectable lacrimal sac due to trauma, previous DCR or dacryocystectomy, Lee *et al*^[21] reported that the mean anatomic and functional success rates of canaliculorhinostomy in patients with distal canalicular obstruction and lacking a structurally functional lacrimal sac to be 87.5% and 81.3% respectively. However, all these previous studies adopted the external approach similar as external DCR. To our knowledge, the technique of common canaliculorhinostomy *via* an endoscopic transnasal approach for the treatment of refractory CCO with an undetectable lacrimal sac has not been previously reported. The high-resolution endoscope provides a direct and magnified visualization of the nasal cavity. This allows for precise and efficient burring, thinning and removal of the superior aspect of the posterior frontal process of the maxilla. In traditional canaliculorhinostomy by the external approach, visualization and maneuverability of instruments is compromised due to the depth and limited working space. This is compounded by the fact that the superior part of the frontal process of the maxilla is relatively thick and strong. Other advantages of endoscopic transnasal approach for chronic dacryocystitis over external DCR include the decreasing incidence of cutaneous scarring, medial canthal webbing and disruption of the lacrimal pump function^[6,12,24-25].

Removal of the superior part of posterior frontal process of the maxilla is essential for adequate exposure of the common canaliculus. Endoscopic approach allows superior part of the frontal process of the maxilla to be removed, creating a larger potential space. This allows the common canalicular ostium to be at the same level or higher than the surrounding soft tissues. This decreases the chance of ostial re-occlusion as the direction of scarring is directed outwards from the ostium. We also believe that the use of MeroGel to line the surroundings of the ostium also plays a significant role in the prevention of ostial re-occlusion due to its effects on wound healing and epithelialization. At the 2-week review, we found that all patients had a healed patent ostium with a lining of intact epithelial mucosa and at the final review, healthy epithelial mucosa lined the ostium in 41 patients. In our previous study, it was demonstrated that the use of MeroGel could improve the success rate of ostial patency for endoscopic endonasal DCR by stimulating wound healing and mucosa epithelialization, and by preventing the formation of fibrotic tissue around the ostium^[24].

Using a lacrimal probe, the distal common canalicular lumen could be easily identified, carefully incised and opened with a sharp sickle knife to precisely prepare a "large" posteromedial common canalicular flap, with minimal injury to the flap. In our own experience, the preparation of the common canalicular flap, including its form and size, determines the success of this

surgery. We also strongly advocate that the “large” common canalicular flap should be well anastomosed to the prepared nasal mucosa flap if possible. Effective removal of the superior part of posterior frontal process of maxilla is required to allow for a good anastomosis between the mucosal flaps. Only when the upper part of posterior frontal process was removed, the edge of “large” posteromedial canalicular flap could be allowed to smoothly contact the border of the isolated nasal mucosa flap with minimal tension. Ideal edge “contact” of the both flaps is critical for wound healing and its epithelization to maintain the ostium patent. This was probably another reason why the anatomic success rate (85.4%) acquired was similar to that of the functional success rate in this study. The thickness and size of the nasal mucosa flap should be similar to the corresponding common canalicular flap to ensure good contact between the flap edges. In addition, the agger nasi cells should be opened when removing the upper frontal process of maxilla. Haemostasis should also be maintained during the entire surgery to allow for good visualization of the surgical field.

Silicone intubation was not performed for any of the cases in this study. Although the overall frequency of stent-related complications have been reported less than 5%, intubation have been associated with various problems including more frequent postoperative reviews, longer surgical duration, formation of false passage, canalicular cheese-wiring, tube prolapse, and granulation tissue formation at the internal ostium^[28]. Various studies have shown that the success rates in endoscopic DCR were similar regardless of whether a silicone stent was used or not^[29-33]. Currently there is no evidence on the efficacy of silicon intubation following endoscopic transnasal canaliculorhinostomy (ETC), and the presence of a foreign body may provoke granulation tissue formation^[34-35]. We also believe that the unobstructed tear drainage may play a role in ensuring wound healing and epithelialization. The presence of a silicone tube may also increase the risk of displacement of the mucosal flaps, resulting in a loss of edge contact between them. Although previous studies^[20-21] used 8 mm of patent lateral canaliculi as the indication for canaliculorhinostomy, we only included patients with an obstruction 12 mm from the punctum. Given that it was the first time that we performed this procedure, we were more conservative with the case selection. If the obstruction were too distal, endoscopic manipulation and fashioning a large posteromedial common canalicular flap for anastomosis may prove to be challenging. Additionally, a thorough understanding of the nasal anatomy as well as experience in endoscopic transnasal surgery is essential for this procedure. The limitations of this study include its retrospective nature and the absence of a control group. As the surgical technique is a novel one, there is limited literature to compare our results to others.

In summary, our study demonstrates that with appropriate patient selection, the surgical outcome of ETC is comparable to that of primary CDCR with a Jones tube. Given the current trend towards minimally invasive surgery, the surgical technique described in this study may pave the way for the evolution of a new surgical technique for refractory CCO with an unidentifiable lacrimal sac.

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