Original Article

Nasal endoscopic features and outcomes of nasal endoscopy guided bicanalicular intubation for complex persistent congenital nasolacrimal duct obstructions

Manpreet Singh, Manjula Sharma, Manpreet Kaur, Aditi Mehta Grewal, Deepti Yadav, Sabia Handa, Sonam Yangzes, Zoramthara Zadeng, Pankaj Gupta

Purpose: To study the clinical presentation, nasal endoscopic features, and outcomes of nasal endoscopy guided (NEG) bicanalicular intubation (BCI) in children with complex persistent congenital nasolacrimal duct obstruction (pCNLDO). **Methods:** A prospective, interventional study including eligible children (age ≤ 12 years) having complex pCNLDO. The demographics, number of previous probings, nasal endoscopy findings, and outcomes; were noted in all children who underwent NEG-BCI with Crawford's stents. Matting of eyelashes (MoE, upper, and lower eyelid), tear-film height (TFH), and fluorescein dye disappearance test (FDDT) was assessed pre and postoperatively. The minimum stent in-situ period was 12 weeks, and the minimum follow-up was 6 months (after stent removal). **Results:** Total 32 children (36 eyes) including 18 females (56.25%) were studied. At a mean age of 4.9 years, all children had epiphora and discharge with MoE (both upper and lower), raised TFH and positive FDDT. Previously, all children underwent conventional probing (s)- once in 12 (33.3%), twice in 18 (50%) and thrice in 6 (16.7%) eyes. The general ophthalmologists performed the majority (n = 21, 58.33%) of those. The BCI was performed under GA in all eyes, and at a mean follow-up of 8.5 months, the "complete" success was noted in 29 eyes (80.5%), 'partial' success in 4 (11.1%) and failure in 3 (8.3%). The stent prolapse was seen in three. **Conclusion:** NEG-BCI may provide a satisfactory resolution to complex pCNLDO after single or multiple failed probings. NEG provides confident and efficient management of coexistent intranasal complexities related to the inferior turbinate and meatus.

Key words: Bicanalicular intubation, CNLDO, failed probing, lacrimal stents, persistent CNLDO

Access this article online
Website:
www.ijo.in
DOI:
10.4103/ijo.IJO_1819_18
Quick Response Code:

Based on the intraoperative findings during lacrimal probing, Jones (1976) and Kushner (1998) divided the congenital nasolacrimal duct obstruction (CNLDO) into two types—simple and complex.[1,2] In simple CNLDO, the obstruction (s) are membranous, near the distal end of the nasolacrimal duct (NLD) and needs minimal force to overcome the resistance during lacrimal probing.[1-4] The complex CNLDO usually feature a firm bony obstruction due to the non-development of NLD, a buried probe variant, the opening of NLD in the lateral nasal wall or inferior turbinate, a tight NLD for a Bowman's no. 1 probe, with or without an impacted inferior turbinate.[1-4] The complex variety is associated with anlages/fistulas, systemic syndromes (Down, Treacher-Collins, Fraser, Rubinstein-Tyabi) or craniofacial abnormalities/syndromes.[5-7]

At any age, the simple CNLDO is easier to treat than the complex variety. The incidence of complex CNLDO rises with age (>24 months) and is associated with higher failures of primary probing, leading to persistent CNLDO (pCNLDO).[8-11] The children with failed probing (s) or pCNLDO should be dealt with nasal endoscopic guidance (NEG) which provides a direct view of the nasal cavity, mucosal health information, inferior turbinate (position, hypertrophy), and the distal end of NLD. This information from NEG is crucial for making the diagnosis of the variety or subset of complex CNLDO and helps to plan tailored management.[6,7,12,13]

Balloon catheter dilatation (BCD) and nasolacrimal duct intubation (NLDI) are potential tools before proceeding with a dacryocystorhinostomy (DCR) in children, as BCD and NLDI may provide a more physiological solution and avoid a pediatric DCR.[14] The choice amongst BCD and NLDI depends fairly on the experience of the surgeon, patient factors, cost-effectiveness, and availability.[7,14,15] Furthermore, the NLDI can be performed as monocanalicular intubation (MCI) or bicanalicular intubation (BCI) depending upon the surgeon's choice for the particular patient.[16,17]

Nasal endoscopy guided lacrimal probing with or without adjunctive procedures can provide a satisfactory outcome in patients with failed probings or persistent CNLDO.[9,14] However, the success rate of both BCD (77%) and NLDI (84%)

Advanced Eye Centre, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Correspondence to: Dr. Manpreet Singh, Advanced Eye Centre, Postgraduate Institute of Medical Education and Research, Chandigarh, India. E-mail: drmanu83@gmail.com

Manuscript received: 01.11.18; Revision accepted: 13.03.19

Cite this article as: Singh M, Sharma M, Kaur M, Grewal AM, Yadav D, Handa S, *et al*. Nasal endoscopic features and outcomes of nasal endoscopy guided bicanalicular intubation for complex persistent congenital nasolacrimal duct obstructions. Indian J Ophthalmol 2019;67:1137-42.

is comparable in failed probings or persistent CNLDO.[9,14] At present, there is a dearth of data regarding the outcomes of NLDI in children with pCNLDO (complex variety) from the northern part of our country. We present our data of pCNLDO patients highlighting the type of CNLDO, number of previous probings, nasal endoscopy findings and the outcomes of NEG-BCI for complex pCNLDO.

Methods

This prospective, interventional study was performed at a tertiary care referral institute in north India. All patients were recruited from the oculoplastics practice of single surgeon (MS) from May 2015 to February 2018. Approval was obtained from the ethics committee to perform this study abiding the tenets of the Declaration of Helsinki as amended in 2008. The chief author (MS) is an experienced, fellowship-trained oculoplastics surgeon with >3 years of experience in nasal endoscopy-assisted lacrimal procedures.

The persistent CNLDO or failed probing was defined as the persistence of symptoms of CNLDO at 6 weeks of the primary or last probing.[18] All diagnosed children of pCNLDO were consecutively recruited into our study, and all cases were subjected to a similar protocol of ophthalmic history, clinical evaluation, nasal endoscopy, BCI using Crawford's stents, minimum stent-in-situ period, stent removal, and post stent removal follow-up. All evaluations and procedures were performed by a single surgeon (MS). The final diagnosis regarding the type of CNLDO (simple or complex) was established during nasal endoscopy-assisted probing during the NLDI.

The inclusion criteria for this study were previously failed probing (once or multiple), children with age < 12 years, the complex variety of CNLDO (previous records or intraoperative findings) and a minimum of 6 months follow-up after stent removal. Exclusion criteria included punctum or canalicular disorders, previous balloon catheter dilatation, previous NLDI, agenesis of NLD, nasolacrimal trauma, and simple variety of CNLDO/pCNLDO. The children who presented with stent extrusion, prolapse or loss ≤12 weeks were excluded from our study.

A detailed history (informants- parents) was recorded focusing on previous probing (s) – age, number and type of anesthesia for previous probings. The associated systemic features and congenital craniofacial anomalies were also noted. All patients underwent clinical evaluation for the matting of eyelashes (MoE) of lower and upper eyelid; tear-film height (TFH) (normal or raised); regurgitation on pressing the lacrimal sac region (ROPLaS); and fluorescein dye disappearance test (FDDT). A detailed lacrimal system evaluation was performed during the procedure under general anesthesia (GA). No child underwent any examination or lacrimal procedure under topical anesthesia or any form of physical restriction. Detailed informed consent (with diagrammatic deliberation) was obtained from the parents of all children for the procedure and the academic use of the full-face picture of their wards.

Procedure- All BCI procedures were performed under GA. Adequate nasal mucosal decongestion was ensured with xylometazoline 0.15% pediatric nasal spray. Both upper and lower puncta were dilated with Nettleship's punctum dilator. Bowman's lacrimal probe no. 1 was passed from the upper punctum overcoming the membranous resistances, till a hard resistance was felt. The probe was kept in the same position without any further movement.

A diagnostic nasal endoscopy was done via both nostrils using a 0°, 2.7 mm Hopkins II telescope, in all cases. The nasal endoscopy findings were recorded highlighting the inferior turbinate (IT) and inferior meatus (IM). The IT was considered 'impacted' when the inferior meatus was not visualized, i.e. no space between the IT and lateral nasal wall, even after satisfactory pre and intraoperative nasal mucosal decongestion. The impacted IT was medialized (or infractured) in all cases using the blunt end of Freer's periosteum elevator followed by decongestion of the nasal mucosa of inferior meatus. Then, the Bowman's probe was pushed under endoscopic visualization, and the tip of the probe was visualized in IM.

After withdrawing the Bowman's probe, the puncta were re-dilated for easier and atraumatic insertion of the olive tips of metal bodkins of Crawford's bicanalicular stents. The metal bodkins were passed akin Bowman's probe, and the olive tip of first metal bodkin [Fig. 1a] was visualized in the IM. It was then hooked with Crawford's hook [Fig. 1b] and pulled out of the nasal cavity. Similarly, the other bodkin was passed, located and pulled out, taking care of the previous silicone stent. The silicone stents were tied into a knot and placed in IM, keeping the length long enough to prevent the punctum cheese-wiring [Fig. 1c].

The stents were kept for minimum 3 months followed by stent removal under brief GA using Crawford's hook to engage and pull the knot. The stent loop was cut [Fig. 1d] from the inter-punctal region, and the engaged stent was removed from the nose [Fig. 1e, f]. No fluorescein dye irrigation or other test was performed under GA. The presence of any granuloma or synechiae was noted.

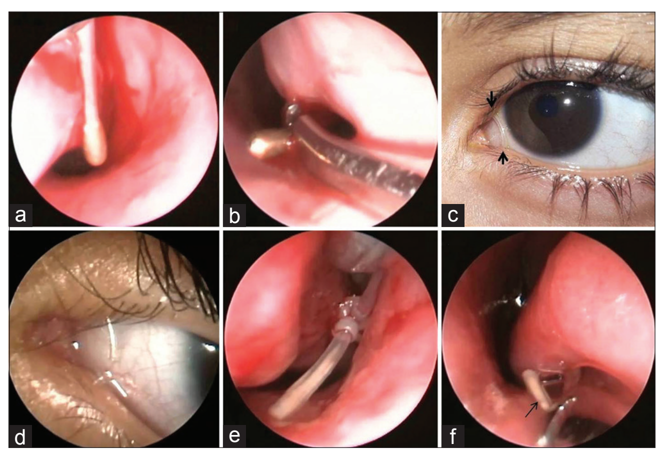

Figure 1: (a) The olive-tip metal bodkin of Crawford's stent visible in the left inferior meatus. (b) The Crawford's hook with the engaged olive tip being pulled out of the left nasal cavity. (c) The loop of BCI stent seen going into left superior and inferior puncta. (d) During stent removal, the loop after cutting with conjunctival scissors. (e) The knot of silicone stents seen in the left inferior meatus. (f) The Crawford's hook being used to engage the loop and pull it out of the nose

The "buried probe" variety was defined as the entire NLD lying submucosally over the lateral wall of the nose, to the floor of the nose, without having an opening into the inferior meatus [Fig. 2a].[19] The buried probe was dealt with a cruciate/horizontal incision over the tip of the submucosal lacrimal probe in the inferior meatus region. The incision was fashioned with either a sickle knife or a no. 11 blade. The rest of BCI was carried out similarly.

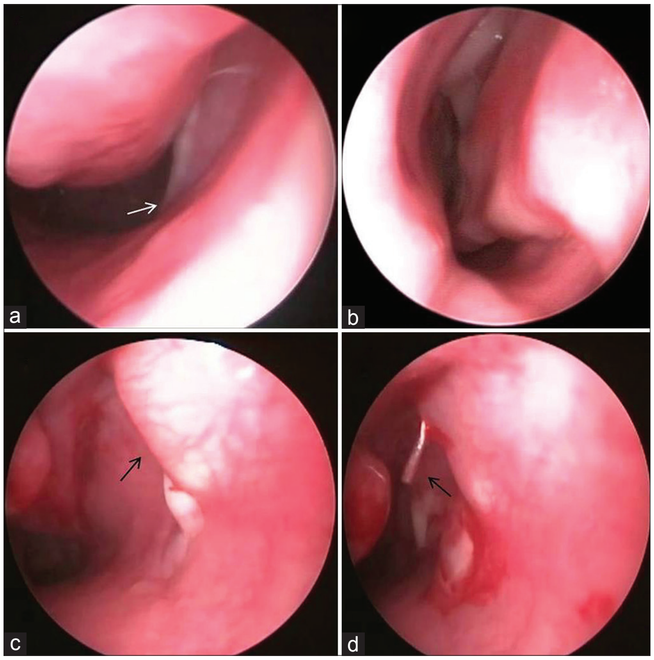

Figure 2: Nasal endoscopic features in complex pCNLDO with 0° 2.7 mm telescope (a) Left nasal cavity (inferior meatus) showing a submucosal probe extending to the floor of the nose (buried probe, white arrow). (b) Endoscopic photograph of the nasal cavity showing an impacted inferior turbinate. (c) Left nasal cavity showing an intranasal cyst (black arrow). (d) The olive tip of metal bodkin seen coming through the opening in mucoperiosteum of the lateral nasal wall (black arrow)

The common postoperative treatment included-nasal decongestant spray xylometazoline 0.15% (BD × 1 month), eyedrops tobramycin 0.3% + fluorometholone 0.1% (QID with weekly tapering), and eyedrops carboxymethylcellulose 1% (4-6 times/day). Lubricating eye ointment was advised at night to prevent the nocturnal irritation. The inter-punctum stent loop was shown to the parents to reduce anxiety and avoid its inadvertent removal. All children were examined on day 1, 7, 14, and 30 to observe the clinical improvement in epiphora and discharge and any stent-related complications. The MoE, TFH, and FDDT were examined at day 14 and 30. A regular 2nd and 3rd-month follow-up visit were ensured. The outcomes were based on the subjective factors—resolution of epiphora and discharge; and the objective factors- MoE, TFH, and FDDT.

- Complete success—no epiphora/discharge, no MoE, normal TFH, and negative FDDT
- Partial success—no discharge, intermittent epiphora, no MoE, raised TFH, and negative FDDT
- Failure—no resolution of epiphora/discharge, with MoE, raised TFH and and positive FDDT

All children with the failure of BCI underwent endoscopic endonasal DCR procedure under GA. The possible complications were divided into-ocular (corneal erosions, superficial punctate keratitis), nasal (frequent bleeding, irritation), and stent-related (slit punctum, stent prolapse, stent loss).

Results

Table 1 summarizes the demographic details of the included children having pCNLDO. At presentation, epiphora, and discharge were the universal symptoms (100%) while the swelling in the lacrimal sac region was reported in 8 (22.22%) eyes. The examination revealed MoE, raised TFH, and positive FDDT in all (100%). A positive ROPLaS test was elicited in 80% (n = 28) of eyes. Interestingly, all previously failed

Table 1: Summary of demographic profile, number of previous probings, and nasal endoscopic findings

No. of children/eyes		32/36	
Laterality (unilateral : bilateral)		28 : 4	
Mean age		4.9 years	
Gender		Females-18 (56.25%), Males-14	
Mean duration of symptoms		11 months	
Surgeons of previous conventional probings		General ophthalmologist (21); Oculoplastics surgeon (15)- all under GA	
No. of previous conventional probings		Outcomes	Complications
Once	12	Complete success- 12	None
Twice	18	Complete success- 17 Partial success- 1	Stent prolapse- 2
Thrice	6	Partial success- 3 Failure- 3	Stent prolapse- 1 Nasal mucosal granuloma
Nasal endoscopy findings		Inferior turbinate (IT)	Inferior meatus (IM)
		Impacted- 22 (61.11%) Hypertrophy- 6 (16.67%) Inflammation- 2 (5.56%)	Buried probe- 7 (19.44%) Fibrous membrane at valve of Hasner- 20 (55.56%) Intranasal cyst- 3 (8.33%) NLD opening in mucosa of IT- 3 (8.33%)

probings were performed in a conventional "probing and dye irrigation" method, under GA in 26 eyes (72.22%) and topical anesthesia + mechanical restraining/mummification of the child in 10 (27.78%) eyes.

All cases underwent a NEG-BCI of one or both ($n = 4$) sides with Crawford's stents. None of the children needed hospital admission. The nasal endoscopy features are summarized in Table 1 [Fig. 2b-d]. All the CNLDO were of complex variety with the features of bony obstruction in 26 (72.2%), of which 22 had impacted IT, and 4 had buried probe. The craniofacial syndromes were seen in 7 (19.44%) eyes affected with pCNLDO. Total 10 patients (12 eyes) had age > 5 years, and all underwent similar NEG-BCI procedure.

Postoperatively, the treatment mentioned above and lacrimal sac compressions (for 1-2 weeks) were advised for all children, with stents in-situ. At 2 weeks and 1-month follow-up visit, the MoE, TFH, and FDDT were assessed with stents in-situ, for objective estimation of the recovery. The mean duration of BCI (in-situ) was 17.5 weeks (range, 14–20 weeks). At an average follow-up of 8.5 months, complete success was noted in 29 (80.55%) eyes while partial success was observed in 4 (11.11%) eyes. The procedure failed in 3 eyes (8.33%), and all three underwent an endoscopic endonasal DCR as the final procedure. In the 3 eyes with failed BCI, all had impacted IT (bony obstruction) and thrice previous probings. Of the 7 eyes which had partial success and failure, 6 had previous conventional probings thrice while in 1 (partial success), it was performed twice. Of 12 eyes (age > 5 years), 10 (83.33%) had complete success at the last follow-up. In our experience, the relief from MoE followed a pattern of earlier resolution of upper eyelash matting followed by the lower eyelashes.

In complications, three children presented with a stent prolapse [Fig. 3a and b] at a mean of 14.7 weeks. All presented with a stent loop prolapse in the morning and in all, the stents were removed under brief GA. Five children complained of transient, self-limiting, conjunctival injection with a foreign-body sensation. One child had a nasal mucosal granuloma which resolved with a short-course (2 weeks) of nasal steroid spray (budesonide). None of our patients developed any punctum cheese wiring, slit punctum, or the corneal abrasion. Table 1 summarises the demographic features, clinical features on nasal endoscopy, and outcomes about the number of previously failed probings.

Discussion

We found the NEG-BCI to be successful in approximately 80% of children with pCNLDO who underwent previous conventional probing/s. None of the previous probings (either first or repeat) were performed under nasal endoscopic guidance. This highlights the uncommon usage of nasal endoscopy during the initial or repeated lacrimal probings for CNLDO in our part of the country. Although, Nair AG *et al.* (2016) reported a survey of Indian oculoplastics surgeons and found that 50% of respondents use nasal endoscopy during the primary probing.[20] However, the knowledge and access to NEG probing are not similar to general ophthalmologists, still performing majority if the probings for CNLDO.

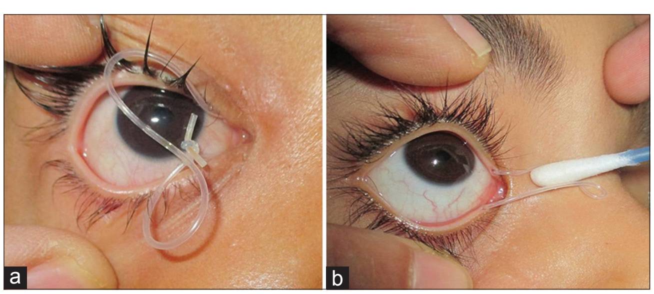

Figure 3: (a) A child with a right-sided stent prolapse with the knot exposure. (b) Another child with a right stent loop prolapse

In literature, the success rate of repeat probing for pCNLDO ranges from 25%-69%.[8-11] The PEDIG (2009) studied 159 children with pCNLDO (failed probing- once) and compared the success of BCD and NLDI, choice based on surgeon's discretion.[14] Sixty percent of the investigators performed NLDI exclusively. The success rate of BCD and NLDI was 77% and 84%, respectively. The participants of PEDIG found similar success rates with MCI, BCI, and BCD provided to children with pCNLDO.[14]

In 1998, Kaufman and Guay-Bhatia introduced monocanalicular intubation (MCI) with a single silicone tube and showed equivalent success with both MCI and BCI.[21] On the contrary, Rajabi *et al.* (2016) studied the pCNLDO patients aged ≤4 years who underwent BCI and MCI with random selections.[16] The overall success was seen in 96.4%, 71.5%, and 47.3% in bicanalicular, Monoka (monocanalicular), and Masterka (monocanalicular) stents, respectively. They concluded that the combined diameter of bicanalicular stents might be responsible for better outcomes than MCI and hence, recommended the use of BCI in the children having pCNLDO.[16]

Table 2 summarises the studies focusing on the BCI used for NLDI and its outcomes in pCNLDO. Based on the published literature (Rajabi *et al.*) and our experience, we believe that the BCI provides better success rate than MCI secondary to its larger combined diameter of 2 stents, knot placement in inferior meatus (ensures the presence of stents in the NLD), and better dynamicity with the blink of both eyelids (both canaliculi stents move better than monocanalicular stent).

Lim *et al.* (2004) used Crawford's BCI in 97 children (122 eyes) having pCNLDO including children having Down's syndrome ($n = 11$, 18 eyes). They showed a success rate of 89% and 85% in children with and without Down's syndrome, respectively and concluded that the syndromic association does not affect the outcomes.[22] A study by Pelit *et al.* (2009) using BCI (Ritleng stents) showed 100% success in 33 eyes with pCNLDO. They concluded that the use of NEG provided an advantage to manage/pull the proximal prolene part attached with the silicone stents.[23]

The standard of care for the management of pCNLDO is a NEG lacrimal probing ± IT medialization ± BCD ± NLDI (MCI or BCI).[23-28] Currently, the role of dacryoendoscopy is getting prominent for an assisted lacrimal probing with simultaneous correction of associated NLD abnormalities. In general, the selection out of above-mentioned techniques depends on the surgeon's expertise, the patient's affordability, and associated physical conditions. Of the balloon catheter, MCI and BCI—the bicanalicular stents are cheaper and readily available in our part of the country. The BCI can either be of Crawford's or Ritleng type and is chosen depending upon its availability, cost, and experience of the surgeon.

Table 2: A mini-literature review of the studies featuring bicanalicular intubation for persistent CNLDO

Author	Year	No. of patients/ eyes	Mean age of patients (range)	Stent used	Complex pCNLDO	Mean duration of stenting	Complications	Mean follow-up	Success
Lim *et al*.[22]	2004	97/122	3.3 years (11 months-9.5 years)	Bi (Crawford's)	All	5.5 months	Stent dislodgement- 30 Slit punctum-6 Infection- 3 Granuloma-1 Corneal erosion- 1	Minimum 1 month (sufficient)	85%- Down's syndrome 89%- no Down's
Yazici *et al*.[23]	2006	42/50	37.3 months	Bi (Ritleng)	26 eyes	3 months	Slit punctum-2	18.1 months	86%
Pelit *et al*.[24]	2009	29/33	5±2 years (2-10 years)	Bi (Ritleng)	All	6 months	Slit punctum- 1	40.32 months	100%
Lee *et al*.[25]	2012	9	23.3 months (9-52 months)	Bi (9/30) Mono (13/30)	All	12.5 weeks	Stent prolapse- 4	16.4±5.9 weeks	93.3%
Ali *et al*.[6]	2014	83/100	45.6 months	BCI (14 eyes)	Of total complex CNLDO: Bony obstruction- 23% CFS- 12% Buried probe- 10%	-	-	4.68 months	58%- anatomical 51%- functional
Kashkouli *et al*.[7]	2016	-/52	26.7 months	Mono & Bi	Yes	11.9 weeks	Lost tubes- 7 (6-mono)	-	95.6%
Rajabi *et al*.[16]	2016	-/248	1-4 years	Mono & Bi	All	-	Dislodging/extrusion of tube- 21 (8.5%) Punctum slitting- 4 Corneal abrasion- 1	3 months (minimum, telephonic)	Complete- 80.2% Partial- 16.2% Failure- 3.6%
Eshraghi *et al*.[17]	2017	47/47	3.56±2.19 years	Mono & Bi (Crawford's)	Yes	3 months	None	12 months (minimum)	74.4%
Our study	2018	32/36	4.9 years	Bi (Crawford's)	Bony obstruction- 28 CFS- 7	17.5 weeks	Stent prolapse- 3 Nasal mucosal granuloma- 1	8.5 months	Complete- 80.55% Partial- 11.1% Failure- 8.33%

*Bi- bicanalicular; mono- monocanalicular; pCNLDO- persistent congenital nasolacrimal duct obstruction; CFS- Craniofacial syndromes

We believe that BCD is a good option for the management of complex CNLDO or pCNLDO but is a costly alternative for our population. The MCI stents (Monoka-Crawford or Masterka) are expensive and not readily available in our part of the country, but if used, can be removed in the OPD under topical anesthesia. The disadvantages of BCI include the need of brief GA for its removal and chances of punctum cheese-wiring or slitting.

In literature, the intraoperative features of punctum, canaliculus, and the feel of NLD obstruction (s) have been amply described during the lacrimal probings. However, the critical associated intranasal findings remain under-reported in CNLDO as the major obstruction is at the distal end of NLD lying in the vicinity of IM and IT. In our study, we have described the decisive intranasal findings which might have a significant role in the failure of previous conventional probings. Following the "obstruction-based treatment" theory of Kashkouli *et al*. (2017),[7] the BCI failed cases underwent endoscopic DCR and the eyes having partial success were also counseled for a DCR suspecting a "scarred" and "functionally-impaired" NLD in them.

The strengths of our study are in its prospective design, single-surgeon intervention, use of nasal endoscopy, homogenous work-up and follow-up of patients. However, the limitations of this study are small sample size and absence of a control arm for comparison of the outcomes. We included the cohort of complex pCNLDO patients with detailed nasal endoscopic evaluation and evaluated the outcomes as complete or partial success and the failure of NEG-BCI.

Conclusion

In conclusion, nasal endoscopy provides better visualization of the intranasal details leading to confident manipulation of the IT, location, and manipulations of the tips of lacrimal probes or metal bodkins of BCI. In pCNLDO, the attributable features like impacted inferior turbinate, buried probe, and intranasal cysts could also be managed under NEG. BCI provides a satisfactory success rate in children having pCNLDO and may help to avoid a pediatric dacryocystorhinostomy. The bony obstructions, craniofacial syndromes, and buried probe were the common etiological factors for complex pCNLDO.

Acknowledgements

Dr.Mohd.Javed Ali, Head, Govindram Seksaria Institute of Dacryology, LVPEI, Hyderabad- for his teachings and support.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Jones LT, Wobig JL. Congenital anomalies of the lacrimal system. In: Surgery of the Eyelids and Lacrimal System. Birmingham, AL: Aesculapius; 1976. p. 162-4.
2. Kushner BJ. The management of nasolacrimal duct obstruction in children aged between 18 months and 4 years. J AAPOS 1998;2:57-60.
3. Wallace EJ, Cox A, White P, Macewen CJ. Endoscopic-assisted probing for congenital nasolacrimal duct obstruction. Eye 2006;20:998-1003.
4. Lueder GT. Endoscopic treatment of intranasal abnormalities associated with nasolacrimal duct obstruction. J AAPOS 2004;8:128-32.
5. Moscato EE, Kelly JP, Weiss A. Developmental anatomy of the nasolacrimal duct: Implications for congenital obstruction. Ophthalmology 2010;117:2430-4.
6. Ali MJ, Kamal S, Gupta A, Ali MH, Naik MN. Simple vs complex congenital nasolacrimal duct obstructions: etiology, management and outcomes. Int Forum Allergy Rhinol 2015;5:174-7.
7. Kashkouli MB, Abtahi MB, Sianati H, Mahvidizadeh N, Pakdel F, Kashkouli PB, *et al*. A novel one-stage obstruction-based endoscopic approach to congenital nasolacrimal duct obstruction. Ophthalmic Plast Reconstr Surg 2017;33:350-4.
8. Kashkouli MB, Beigi B, Parvaresh MM, Mahvidizadeh N, Pakdel F, Kashkouli PB, *et al.* Late and very late initial probing for congenital nasolacrimal duct obstruction: What is the cause of failure? Br J Ophthalmol 2003;87:1151-3.
9. Pediatric Eye Disease Investigator Group, Repka MX, Chandler DL, Bremer DL, Collins ML, Lee DH. Repeat probing for treatment of persistent nasolacrimal duct obstruction. J AAPOS 2009;13:306-7.
10. Maheshwari R. Success rate and cause of failure for late probing for congenital nasolacrimal duct obstruction. J Pediatr Ophthalmol Strabismus 2008;45:168-71.
11. Honavar SG, Prakash VE, Rao GN. Outcome of probing for congenital nasolacrimal duct obstruction in older children. Am J Ophthalmol 2000;130:42-8.
12. Cakmak SS, Yildirim M, Sakalar YB, Keklikci U, Alakus F. Is it necessary to accompany probing with endoscopy in cases of congenital nasolacrimal canal obstruction? Int J Pediatr Otorhinolaryngol 2010;74:1013-5.
13. Al-Faky YH. Nasal endoscopy in the management of congenital nasolacrimal duct obstruction. Saudi J Ophthalmol 2014;28:6-11.
14. Repka MX, Chandler DL, Holmes JM, Hoover DL, Morse CL, Schloff S, *et al.* Balloon catheter dilation and nasolacrimal duct intubation for treatment of nasolacrimal duct obstruction after failed probing. Arch Ophthalmol 2009;127:633-9.
15. Lin AE, Chang YC, Lin MY, Tam KW, Shen YD. Comparison of treatment for congenital nasolacrimal duct obstruction: A systematic review and meta-analysis. Can J Ophthalmol 2016;51:34-40.
16. Rajabi MT, Zavarzadeh N, Mahmoudi A, Johari MK, Hosseini SS, Abrishami Y, *et al.* Bicanalicular versus monocanalicular intubation after failed probing in congenital nasolacrimal duct obstruction. Int J Ophthalmol 2016;18:1466-70.
17. Eshraghi B, Jamshidian-Tehrani M, Mirmohammadsadeghi A. Comparison of the success rate between monocanalicular and bicanalicular intubations in incomplete complex congenital nasolacrimal duct obstruction. Orbit 2017;36:215-7.
18. Kamal S, Ali MJ, Gauba V, Qasem Q. Congenital nasolacrimal duct obstruction. In: Javed Ali M, editor. Principles and Practice of Lacrimal Surgery: Springer India; 2015 p. 117-31.
19. Gupta A, Kamal S, Javed Ali M, Naik MN. Buried probe in complex congenital nasolacrimal duct obstructions: Clinical profiles and outcomes. Ophthalmic Plast Reconstr Surg 2015;31:318-20.
20. Nair AG, Kamal S. Indian survey on practice patterns of lacrimal and eyelid disorders (iSUPPLE) report 1: Congenital nasolacrimal duct obstruction. Int J Pediatr Otorhinolaryngol 2016;88:7-12.
21. Kaufman LM, Guay-Bhatia LA. Monocanalicular intubation with Monoka tubes for the treatment of congenital nasolacrimal duct obstruction. Ophthalmology 1998;105:336-41.
22. Lim CS, Martin F, Beckenham T, Cumming RG. Nasolacrimal duct obstruction in children: outcome of intubation. J AAPOS 2004;8:466-72.
23. Pelit A, Caylakli F, Yaycioglu RA, Akova Y. Silicone intubation with the Ritleng method using intranasal endoscopy to treat congenital nasolacrimal duct obstruction. Int J Pediatr Otorhinolaryngol 2009;73:1536-8.
24. Yazıcı B, Akarsu C, Salkaya M. Silicone intubation with the Ritleng method in children with congenital nasolacrimal duct obstruction. J AAPOS 2006;10:328-32.
25. Lee H, Ahn J, Lee JM, Park M, Baek S. Clinical effectiveness of monocanalicular and bicanalicular silicone intubation for congenital nasolacrimal duct obstruction. J Craniofac Surg 2012;23:1010-4.
26. Hu M, Wu Q, Fan YW, Cao WW, Lin Q, Yu G. Comparison of balloon catheter dilatation and silicon intubation as the secondary treatment for congenital nasolacrimal duct obstruction after failed primary probing. Zhonghua Yan Ke Za Zhi 2016;52:123-8.
27. Theodoropoulou S, Sutherland MS, Haddow K, Blaikie A. Success rates of endoscopic-assisted probing for congenital nasolacrimal duct obstruction in children. J Laryngol Otol 2013;127:794-8.
28. Červenka S, Matoušek P, Komínek P. [Comparing of Treatment Results of Monocanalicular and Bicanalicular Intubation in Inborn Lacrimal Duct Obstruction]. Cesk Slov Oftalmol 2016;72:178-81.