



Research Article

Towards a Better Dacryocystorhinostomy, Evaluation of Multimodal Surgical Techniques in Nasolacrimal Duct Obstruction

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ABSTRACT

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Background: This study aimed to evaluate the outcome of long-term results of dacryocystorhinostomy (DCR) techniques in specialized eye care center in Iraq.

Subjects and Method: This is a prospective study of 650 patients from July 2014 to July 2019 with nasolacrimal duct obstruction in Ibn Al Haitham Eye Teaching Hospital. A preoperative questionnaire was done, then one month, three months, six months and one year postoperatively. The success of surgery defined as follow; Absence of epiphora completely, Resolve of dacryoceles or mucoceles or any new attack of dacryocystitis, Appearance of fluorescein dye from nose in fluorescein disappearance test, Successful irrigation of nasolacrimal duct which is proofed endoscopically. The three types of surgery (External, Endoscopic and Transcanalicular Laser DCR) were discussed to the patient then preferred one is chosen. The results and complication were recorded.

Results: A total of 650 patients were included in this study, all were operated by same surgeon. The mean age of patients for external, endoscopic and Transcanalicular laser DCR (T-DCR) were 57, 44 and 51 years old respectively. The female patients were more than the male patients in all types of DCR surgeries and they represent 73.84% of total patients of external DCR (ext-DCR), 78.28% in endoscopic DCR (endo-DCR) and 55.15% in TCL-DCR. A satisfied patient to outcome according to surgery type was 91.20% with ext-DCR, 88.70% with endo-DCR and 51% with TCL-DCR.

Conclusion: The most satisfied techniques to patients with higher success rate are the ext-DCR and endo-DCR while the TCL-DCR is still evolving with limit indications and lower success rate.

Introduction

Obstruction of NLD is the cause of epiphora. This disorder of tear drainage is of three types; (1)

Anatomical obstruction; congenital or acquired disorders may occur at any part along the duct starting from the punctum till the valve of Hasner. The congenital cause is usually a membranous obstruction at

valve of Hasner while the acquired cause is infectious, inflammatory, neoplastic, traumatic or mechanical.

Functional cause (lacrimal pump failure) during blinking, the contraction of deep heads of pretarsal and preseptal orbicularis oculi muscle lead to suction effect that draws the tear to the lacrimal apparatus e.g. facial palsy.

Secondary epiphora; caused by tear film instability and/or ocular surface disease e.g. dry eye, corneal irritation, conjunctivitis, etc. Antiglaucoma and chemotherapeutics also considered as a cause for secondary epiphora.

DCR is surgery of choice that resolves nasolacrimal duct (NLD) obstruction. Many methods reported, but the ext-DCR still the gold standard surgery. This type of surgery was introduced by Addeo Toti in 1904 who made access to lacrimal sac through the skin (2). In 1920 Dupuy-Dutemps and Bourguet made the basis of the modern technique by suturing the anterior and posterior flaps which is performed till nowadays. (3)

The second most common approach for surgery is the endoscopic type. Its principles were introduced by Caldwell in 1893 prior to external approach but its popularity and success grow only in recent time when the revolution of endoscopic surgery appeared. (4)

Mc Donogh and Meiring did their first study on endoscopic DCR on 1989 after that many surgeons upgrade their skills in that way (5). Many reasons encourage the endonasal approach; mainly: No skin scar of that with ext-DCR, No canthal region damage and cosmetic complication.

Very easy approach to abort nasal deviation and NLD obstruction in one step combined surgery,

Preserve pump mechanism that may impaired in external approach due to injury to orbicularis muscle, less bleeding, the success rate is near or equal to ext-DCR, useful with revision surgery.

The evolution of intranasal approach of DCR surgery started after 1980 when FESS surgery (functional endoscopic sinus surgery) developed in association with invention of new and advanced instruments. Massaro et al is the first who state the use of laser in lacrimal surgery (6) and after that different laser DCR surgeries were shared leading to the lastly and most commonly applied, the diode laser TC-DCR, by Eloy et al at 2000 due to the fact that the diode laser has a little collateral effect on surrounding tissue and its good osteotomy effect on nasal bone. (7).

Subjects and Methods

This is prospective cross-sectional comparative study of 650 patients who did DCR surgery with either ext-DCR, endo-DCR or TCL-DCR in Ibn Al Haitham Teaching Eye Hospital, Baghdad, Iraq for the period from July 2013 to July 2019.

The complain of all patients was epiphora. Other manifestation of acute or chronic dacryocystitis were recorded such as swelling, tenderness and redness over the sac region and almost all patient had hard stop of cannula (the cannula reach the medial sac wall namely the nasal bone) during syringing test.

Nasal assessment by portable nasal endoscope in order to design the type of surgery, if no significant nasal deviation, no polyp, no turbinate hypertrophy that interfere with endoscopic or laser work then either endo or TCL-DCR decided, otherwise ext-DCR were performed. Only one case had severed nasal deviation and refused ext-DCR because of nasal scar so she referred to otolaryngologist and combined septoplasty with DCR done and excluded from this study. All cases with abnormal mass or swelling unrelated to lacrimal system or any case with bloody discharge were send first for further checking by CT scan, consultation of maxillofacial or

otolaryngologist. Anesthesiologist consultation for fitness to general or local anesthesia. Laboratory investigation including CBC, blood sugar, urea and serum creatinine in addition to bleeding and clotting time. In general, patients below 50 years old were preferred for GA, older patients preferred for LA with intravenous sedation.

All cases were had epiphora for more than 6 months and they did syringing with hard stop to exclude upper NLD obstruction (positive to the sac), reflux of saline from upper and/or lower punctum indicate distal obstruction. If the cannula was " positive to the sac " then the saline reach the nasal cavity " positive to the nose " then the NLD is intact or partially obstructed. here lacrimal pump failure should be excluded.

Dye disappearance test done and compare it to the other eye and by injecting saline to wash the sac we can differentiate between anatomic and functional obstruction.

Decision for the type of DCR taken by the surgeon after discussion with the patient regarding the success rate, possible complications, cosmetic scar and rehabilitation. Informed consent signed by the patient and all cases in this study were operated by one surgeon.

Nasal pack soaked in nasal decongestant and LA (XylometazolineR 0.1%) and adrenaline 1/100000 was inserted 15-20 minutes preoperatively for all patients.

External DCR (ext-DCR)

This is the gold standard type of DCR surgery suitable when other types failed or unreliable and when there is moderate to severe nasal deviation, traumatic or infectious dacryocystitis when the normal anatomy were changed, here the relative wide field of exposure of duct and its related structures.

Exclusion criteria for this type in this study were:

Patients on anticoagulant e.g. uremic patients on continuous wash, history of heart valve surgery, Patients who failed to get fitness for anesthesia, and functional secondary epiphora.

Surgical technique

Nasal packing soaked with xylometazoline 0.1% and adrenaline 1/200000 inserted to the nose trite of obstructed side (previously marked with surgical marker) for about 15 minute and removed prior to surgery.

Longitudinal or curvilinear incision of 10-15 mm length along the lacrimal crest region and 4mm from the medial can thus avoiding the angular vein (10mm from the medial canthus) then by curved forceps dissection of orbicularis muscle fibers till reaching the lacrimal bone, medial canthal ligament exposure is a landmark behind it lie the fundus of the sac. By Freer elevator, sac separation and exposure of lacrimal sac fossa then periosteum is separated from the anterior lacrimal crest posteriorly to the fossa. Ostium is created by piercing the thin bone of the post lacrimal fossa by Freer elevator then punching the bone by Rongeur Kerrison punch till the size of the ostium reach the size of fingertip, nasal mucosa now is exposed. Inflation of the sac by viscoat ophthalmic solution or BSS then H shaped incision done to create anterior and posterior flaps. Nasal mucosa is injected with 1/200000 adrenalin with xylocaine from the site of ostium in order to separate it from the underlining bone and to decrease the bleeding during anterior and posterior mucosal flap

creation. After the suturing the posterior flaps (mucosal and sac) together by 6/0 vecryl suture, Crawford stent is inserted from the punctum to the nasal cavity through the sac then suturing the anterior sac flap to the anterior mucosal flap by 6/0 vecryl suture. Suturing the orbicularis muscle fiber then the skin. From nostril, nine knots tying of Crawford stent done with the 1st two knots deeply situated to prevent postoperative stent extrusion, merocel nasal packing that removed on second postoperative day. Ceftriaxone vial bid was given at day of surgery then oral ciprofloxacin or co-amoxiclav tablets with acetaminophen 500mg tablets bid for seven days later. Nasal pack removed carefully on second day then daily nasal wash by nasal steroidal and sodium chloride spray for one week for the former and two weeks for the second, ofloxacin 0.3% eye drops qid for 7-10 day.

Follow up the patient in the 1st week, 1st month and in the 2nd month during which maintenance of ostium patency achieved by removing any crust endoscopically or by syringing. After 3-6 months the Crawford stent is removed by endoscopy.

Endoscopic DCR (endo-DCR)

Patients with chronic dacryocystitis or epiphora caused by lower NLD obstruction are candidate for this type of surgery. Patients who are unfit for endoscopic DCR are those with canalicular stenosis, secondary functional epiphora, children below 5 years old, sever nasal deviation or nasal pathology like polyps, active granuloma or malignancy.

All patients assessed for fitness for GA, although LA done for those who are old age or young but not tolerate GA due to respiratory difficulties, high risk for aspiration pneumonia or uncontrolled bleeding (limited cases).

Surgical technique: Under GA, with anti-Trendelenburg position, the patient's head is elevated higher than the feet by 15 -30° in supine position and head tilted posteriorly towards the surgeon head. Nasal pack soaked with 1/200000 adrenaline and xylometazoline hydrochloride is applied for about 15 minutes prior to surgery. With 4mm 0° rigid endoscope, maxillary line and middle turbinate were identified, injection of operative site of mucosa with 1/100000 adrenaline using dental syringe to achieve decongested area.

Mucosal flap creation by making incision starting 8 mm above the axilla of middle turbinate then extend it anteriorly 10 mm on the maxillary line making the flap just above the inferior turbinate. The incision extends superiorly to the agar nasi cells of ethmoid and inferiorly to the maxillary line avoiding the highly vascularized inferior turbinate border. Flap elevation with sharp Freer's elevator and bone exposure which punched by Kerrison punch starting from inferior and ascending superiorly till removing the frontal process of maxilla and expose the lacrimal sac behind. Probing the sac through the punctum and trying to tent it medially through the ostium to confirm the anatomy, incise the layers of lacrimal sac by sickle knife then evacuate and aspirate the sac contents of pus. Anterior and posterior flaps created; the latter is removed by sharp blacksey forceps. Crawford stent is intubated through the upper and lower puncta and tight it from the nasal cavity 3-4 mm below the level of the ostium. Merocil pack inserted into the nose.

Postoperative care of oral antibiotic (Augmentin) 625mg tid or ciprofloxacin 500mg bid prescribed, nasal pack is removed on second postoperative day with prescription of steroidal nasal spray for one week and saline nasal spray for two weeks. Stent removal usually after 6-12.

Transcanalicular Laser Assisted dacryocystorhinostomy (TCL-DCR)

This is a minimally invasive DCR technique that gains popularity with progressing outcome. In this incision free technique with less bleeding and shorter operating time, a diode laser ARC fox machine with wavelength of 810nm and CW mode of action and 400nm or 600nm fiber optic. The procedure performed under local anesthesia (LA) by injecting of xylocaine 2% with adrenaline 1/100000 given by 5ml syringe, G27 needle to the infraorbital foramen and lacrimal sac area to block the infraorbital and infratrochlear nerve respectively. External branch of anterior ethmoidal nerve block done by injecting the LA deeply to the side of nose to avoid swelling that obstruct the view to punctum, Figure 1.



Figure (1): performing nerves block.

Nasal pack soaked with adrenaline 1/1000 and xylometazolin nasal spray inserted to the nasal cavity for 10 minute after xylocaine 10% nasal spray application. Nasal submucosal infiltration with xylocaine 2% and adrenaline 1/100000 is applied to the area anterior to maxillary line and to area of the middle turbinate to insure surgical dry field, Figure 2.



Figure (2): Otrivin nasal spray and adrenalin nasal pack.

Punctal dilatation and probing using Nettle ship dilator and Bowman's probe respectively then prepare the ARC fox laser machine probe by inserting the fiber optic inside and exposing it for 5-10mm to enhance its control inside the NLD and prevent canalicular break if it is too long exposed, Figure 3.

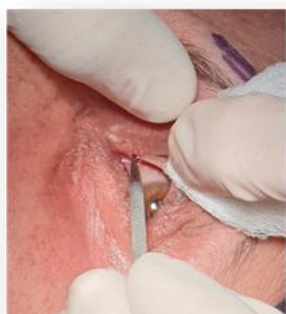


Figure (3): Punctal dilatation and probing

After removing the nasal pack, a rigid nasal (4mm*75mm-0o angle) endoscope is inserted through nasal cavity to identify the laser aiming beam transmucosal through the lacrimal bone. The laser parameters setting according to bone thickness and osteotomy response ranging between 8-12 Watt. Direct the laser probe downward through the NLD preventing the Sump syndrome which is a cause of surgery failure.

Anterior to the middle turbinate and in front of the maxillary line by 8-10 mm the osteotomy is performed under direct viewing of laser shots by endoscope. Crawford stent is inserted through upper and lower puncti and tied by 7-9 knots preferably up and just below the lacrimal sac to avoid tube dislodgement and not stick on sac to avoid ostium closure by the knot.

Postoperative care and medication in form of topical eye drops of antibiotics such as quinolone group (oflox 0.3%) qid for two weeks and steroid (dexamethasone) qid for 10 days. Steroidal nasal spray (Nasonex 50 microgram) started in the 2nd postoperative day and (after removal of merocil nasal pack) twice daily for 10 days. Nasal wash with physiologic isotonic saline applied for 2-3 weeks. Systemic antibiotic (amoxicillin/clavulanic acid 625mg, tid) for 7-10 days.

Inclusion criteria for TCL-DCR in this study were:
 Nasal syringing with 'positive to the sac' result.
 No significant nasal cavity pathologies such as sever septal deviation or pathological cavity obstruction.
 Chronic epiphora in patient unsuitable for GA.
 While exclusion criteria for this type of surgery in this study were:
 Upper NLD obstruction proximal to the sac.
 Significant obstructive nasal pathology such as sever septal deviation, polyp or tumor.
 Significant eye lid pathology medial canthal cicatricial scar, ectropion or entropion.
 Age below 4 years
 Chronic dacryocystitis with lacrimal sac mucocele and mucopurulent discharge.

A set of printed questions with a choice of answers, devised for this study in order to assess the patients and chose the proper type of DCR surgery and for follow up them and determine the success rate of operation. The questionnaire includes the patients name, age, gender, occupation, Chief complaint and duration (Epiphora, Sticky eye, Dacryocystitis, Trauma, Previous NLD surgery, Side of pathology (right or left), table 1.

Table (1): Assessment tools and questions

Preoperative			
Lid exam	Laxity	ectropion	entropion
Sac palpation	Not palpable	palpable	Tears reflux
Fluorescein dye test	Present after 10min		Disappear
Jones dye test I	+ve		-ve
Jones dye test II	+ve		-ve
Syringing test	Saline in nose		reflux
Probing test			
Rhinoscopy			
CT/MRI			
Operative			
Anesthesia	LA		GA
Type of DCR	Ext-DCR	Endo-DCR	TCL-DCR
Duration	<30min	30-60min	>60min
Post-operative			
Pain			
edema			
complication			
Follow up			
1st week			
1st month			
3rd month			
6th month			
1 year			
Stent removal	< 3months	3-6 months	>6 months
Patient satisfaction	Not satisfied	Accept	Satisfied
Success surgery	Succeed		failed

For all patients in the 1st post-operative day, pain assessment using Wong-Baker faces was applied.

Results

In this retrospective study, three types of DCR surgery were evaluated with a total number of 650 patients included (192 males and 458 females) from the period of July 2014 to July 2019 in Ibn Al Haitham Eye Teaching Hospital.

The Statistical Analysis System- SAS (2012) program was used to detect the effect of difference factors in study parameters. Chi-square test was used to significant compare between percentage. Least significant difference –LSD test (Analysis of Variation-ANOVA) was used to significant compare between means in this study.

A 235 (36%) of patients were operated with ext-DCR, 221 (34%) operated with endo-DCR and 194 (30%) with TCL-DCR, figure 4.

The female patients represent 75.7% of total patients of ext-DCR (n =178), 78.3% in endo-DCR (n = 173) and 55.2% in TCL-DCR (n =107); table 2.

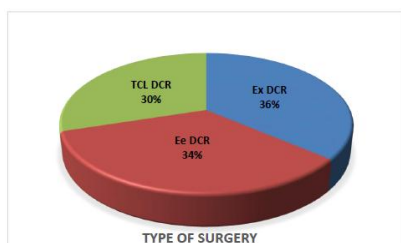


Figure (4) percentage of each DCR type

Table 2: Distribution of sample study according to sex

Type	Sex	No (%)	P-value
Ext-DCR (No= 235)	Male	57 (24.26%)	0.0001 **
	Female	178 (73.84%)	
Endo-DCR (No= 221)	Male	48 (21.72%)	0.0001 **
	Female	173 (78.28%)	
TC- DCR (No = 94)	Male	87 (44.85%)	0.0427 *
	Female	107 (55.15%)	

* (P<0.05), ** (P<0.01).

Mean age of patients for external, endoscopic and TCL-DCR were 57, 44 and 51 years old respectively, table 3.

Table 3: Mean and SE of age of patients according to type

Type	No	Mean ± SE of age (year)
Ext-DCR	235	57.00 ± 2.88 a
Endo-DCR	221	44.00 ± 1.74 b
TCL-DCR	194	51.00 ± 2.63 a
LSD value	---	5.042 **
P-value	---	0.0001

Means having with the different letters in same column differed significantly, ** (P<0.01).

Satisfied patients to outcome according to surgery type were 91.20% with ext-DCR, 88.70% with endo-DCR and 51% with T-DCR, table 4.

Table 4: Distribution of sample study according to outcome (satisfied patients)

Type	No	Percentage (%)
Ext- DCR	235	91.20
Endo-DCR	221	88.70
TCL-DCR	194	51.00
Chi-Square(χ^2)	---	9.027 **
P-value	---	0.0001

** (P<0.01).

Discussion

In this study, the higher success rate is with the ext-DCR (91.2%). This result is comparable to previous studies namely; Cokkeser Y (89.8 %), Tarbet KJ (92%), Mekonnen W (93%) and Hartikainen J (91%) (8) (9) (10) (11) while Ozer S. study show higher rate (96%). (12)

A nearly similar result (88.7%) is achieved with endo-DCR and is also comparable to results achieved by previous studies; Cokkeser Y (88.2%), Hartikainen J (75%) and Plaza study (88%) (8) (9) (13), while Ozer S. study still show significant higher success rate (100%) (12).

Although endo-DCR show a little lower success rate than ext-DCR, it shows superior outcome related to cosmetic convenient, less bleeding and shorter operative time.

The success rate of TCL-DCR is (51%), compared to Koch KR study that state 78% success rate, Wali U who state 60.8% and Balikoglu-Yilmaz M (73.3%). (14-16)

The low success rate belongs to the TCL-DCR relative to the previous two procedures is attributed to the small ostium that may closed within months later, but still with this type of DCR getting the advantages of performing the surgery under local and regional anesthesia mainly in young patients and in olds who cannot tolerate the general anesthesia, add to that the fast healing rate, the perfect cosmetic result, less bleeding and the ease of procedure in presence of good facilities. We advise this procedure primarily for old patients who have the risk of general anesthesia and who doesn't have the signs of chronicity.

For those with chronic dacryocystitis; long history of epiphora, recurrent ocular infection and puffy lump near medial canthus who may not benefit from TCL-DCR and need bigger ostium, Endo-DCR or Ext-DCR are advisable.

Conclusion

The most satisfied techniques to patients with higher success rate are the ext-DCR and endo-DCR while the TCL-DCR is still evolving with limit indications and lower success rate.

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Conflict of Interest

No conflict of interest

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