Rhinology

External vs. endonasal dacryocystorhinostomy: has the current view changed?

Dacriocistorinostomia esterna ed endonasale a confronto: si è modificata l'opinione comune?

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SUMMARY

In past years, external dacryocystorhinostomy has been considered the gold standard in terms of functional outcome for treatment for nasolacrimal duct obstruction. In comparison, interest in the use of the recently developed endonasal dacyocystorhinostomy procedure has been rekindled because of advances in instrumentation. For the past 10 years, differences in the outcomes between the two techniques have been reduced; thus, currently, the choice of the type of surgery is associated with the experience of the surgeon, resources available in the healthcare system and patient preferences.

KEY WORDS: Epiphora • Nasolacrimal duct obstruction • Dacryocystorhinostomy • Endonasal endoscopy

RIASSUNTO

In passato la dacriocistorinostomia per via esterna (EXT-DCR) è stata considerata il gold standard in termini di risultato funzionale nel trattamento delle ostruzioni del dotto naso lacrimale. L'innovazione della strumentazione ha recentemente incrementato l'interesse per la dacriocistorinostomia endoscopica per via endonasale (EES-DCR). Negli ultini 10 anni le differenze in termini di risultati tra le due tecniche chirurgiche sono andate riducendosi; la scelta del tipo di tecnica chirurgica è attualmente legata all'esperienza del chirurgo, alle risorse economiche del sistema sanitario e alle preferenze del paziente.

PAROLE CHIAVE: *Epifora • Ostruzione del dotto naso-lacrimale • Dacriocistorinostomia • Endoscopia endonasale*

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Introduction

Nasolacrimal duct obstruction (NLDO) inhibits the flow of tears from the eye to the nose, leading to symptoms of epiphora. The clinical spectrum of epiphora ranges from the occasionally trickle to chronically irritating overflow of tears. Epiphora results from a disruption in the balance between tear production and drainage [1]. NLDO is a disorder in which the symptomatology and objective findings do not often consistently correlate. Chronic dacryocystitis is the permanent obstruction of the nasolacrimal duct.

The usual causes of stenosis of the nasolacrimal drainage system include chronic or acute inflammation, traumatism and congenital malformations [2-4]. Tears from the conjunctival sac pass through the lacrimal puncta in the upper and lower lids to the upper and lower lacrimal canaliculi and then to the common canaliculi to empty into the lacrimal sac located in the lacrimal fossa. From the lacrimal sac, tears pass to the nasolacrimal duct along the lateral wall of the nose into the inferior meatus.

Secondary acquired lacrimal drainage obstruction can result from a wide variety of infectious, inflammatory, neoplastic, traumatic or mechanical causes. Bacteria, viruses, fungi and parasites have all been implicated in infectious lacrimal drainage obstruction. Inflammation can also occur through endogenous sources, such as Wegener's granulomatosis, sarcoidosis and sclerodermia or exogenous sources, such as radiation, systemic chemotherapy and bone marrow transplantation. The observed neoplasms include primary growth, secondary spread or metastatic spread. Trauma can be iatrogenic or accidental. Mechanical lacrimal drainage obstruction can result from the presence of intraluminal foreign bodies, such as dacryoliths or casts. Females are affected more than males. The higher incidence of females undergoing DCR has been attributed to social and anatomical factors, as anatomical studies of the nasolacrimal system, using radiological techniques, have shown that its dimensions are smaller in females than in males [1]. NLDO is typically treated using external dacryocystorhinostomy (EX-DCR), in which the lacrimal

sac is directly connected to the nose through the removal of the layers of bone and mucosa that separate these two structures.
The development of fine nasal surgical instrumentation has rekindled an interest in the endoscopic endonasal approach (EES-DCR). A review of the literature concerning the outcomes and complications of these surgical techniques is discussed and compared.

Patient clinical evaluation

Patients with a history of tearing, dacryocystitis, or both should be treated through a standard clinical workup that includes the documentation of the tearstrip level, examination of the eyelids for punctual malpositioning, horizontal laxity or orbicularis weakness, compression over the lacrimal sac to observe mucoid or purulent reflux and irrigation through the canaliculi to document the patency of the lacrimal outflow tracts. Dacryocystography can be performed, and the examination of the nasal cavity is recommended [5,6]. Obstructions observed with on syringing and probing or lacrimal scintigraphy are used for diagnosis of NLDO [7]. Lacrimal scintigraphy is a "physiological" test [7,8] that is likely to yield abnormal results in patients with FNLDO ("functional" nasolacrimal duct obstruction).

Treatment

Dacryocystorhinostomy (DCR) involves the creation of an alternative route for the drainage of tears between the lacrimal sac and nasal cavity, bypassing the nasolacrimal duct. This alternative route is generated using an external approach (external DCR) or through the nasal cavity using an endoscope (EES-DCR). Research suggests the use of general anaesthesia [5] and, more recently, the use of local anaesthesia has also been proposed [8] for both techniques.

External dacryocystorhinostomy

Addeo Toti first described external DCR in 1904, and with the exception of minor changes, DCR is currently performed in much the same way. Toti suggested that gaining access to the sac using an external approach, where the area of the sac adjacent to the canaliculi is preserved and absorbed into an area of the nasal cavity where the nasal mucosa has been removed [10]. Mucosal anastomosis, with suturing of the mucosal flaps, was later described [10].
A 1.2-cm vertical skin incision is typically made at 1 cm from the medial canthus to reduce the risk of scars and avoid the angular vessels (Fig. 1). A nasal tamponade is applied to induce vasoconstriction using a gauge soaked in adrenaline, diluted (1:100,000) or (1:200,000), for 10 min. The periosteum at the anterior lacrimal crest is incised using a Traquair's periosteal elevator and subsequently the lacrimal fossa is entered. The lacrimal and maxillary bones are removed using Kerrison rongeurs to create a large rhinostomy (Fig. 2) [9]. The lacrimal sac and nasal mucosa are opened longitudinally, the sac contents are examined, and a silicone stent is routinely inserted and tied loosely to prevent cheese wiring of the canaliculi. Patency of the internal punctum is confirmed. Some surgeons remove the nasal mucosa entirely to the margins of the osteotomy window using monopolar needle-tip cautery and the edge of the lacrimal sac anterior flap is sutured to the periosteum of the lip at the osteotomy site [5]. Other surgeons [12] open the nasal mucosa longitudinally and suture the posterior and anterior mucosal flaps to the flaps of the lacrimal sac. Still other surgeons create an anastomosis between the anterior flaps and remove the posterior flaps (Fig. 3) [9]. In a recent study, Turkcu showed that there was no statistically significant difference between DCR using both anterior and posterior flap anastomosis and DCR using only anterior flap anastomosis [13]. Subsequently, a running 6-0 polypropylene skin suture is

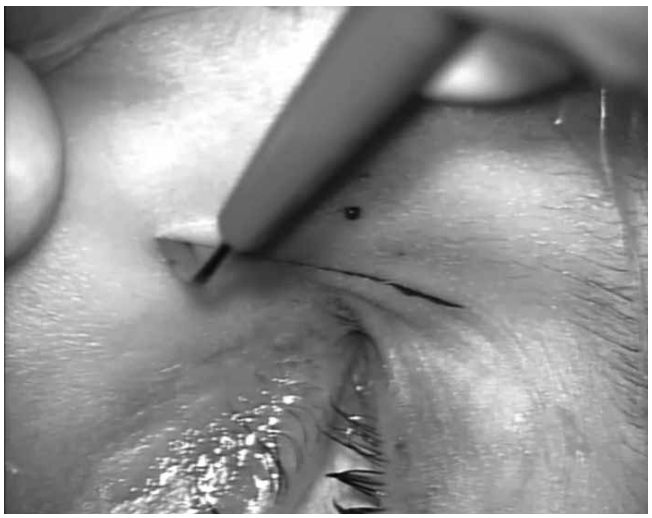

Fig. 1. Vertical skin incision at medial canthus.

Fig. 2. Rhinostomy.

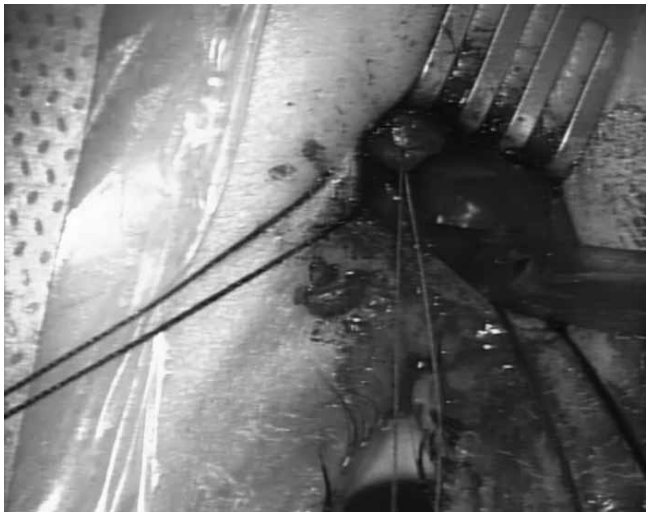

Fig. 3. Anastomosis between the anterior flaps.

applied. A large bony resection of 15-20 mm in external DCR is required to ensure a large anastomosis and high success rate [14].

Lindberg studied a series of 22 external DCR and found no statistically significant correlation between the size of the bony opening and the final outcome of the resection [15].

Regarding silicone tube removal, Karim left the tubes in situ for 1-2 months [7], while Cheung proposed that intubation with silicone tubes should remain for only 3-4 weeks [1-7].

The role of antimetabolites for the maintenance of patency in external DCR is currently being studied. Intraoperative mitomycin C (MMC) application is a safe adjuvant for reduction of the closure rate of the osteotomy site after primary EX-DCR [16].

Shine reported a significantly higher success rate in the MMC group compared with the control group [17]. In two randomized, controlled clinical trials (RCTs), the mean osteotomy size at 6 months postoperatively was significantly larger in the MMC group than in the control group (approximately 27 mm in the MMC group *vs.* and 12 mm in the control group in the first study, and approximately 22 mm in the MMC group and 18 mm in the control group in the second study; $p < 0.005$). No intraoperative or postoperative complications were recorded in the MMC group, except for two cases with delayed healing of the external skin wound (Table II) [16].

Endoscopic endonasal dacryocystorhinostomy

Caldwell first described the endonasal approach in 1893 [18]; however, the use of this method lost popularity because of the difficulty in accessing the narrow nasal cavity using the instrumentation available. The endoscopic procedure has became more popular in last decade due to the advancement of the nasal endoscope and familiarity of endonasal treatment for surgeons with experience in the endoscopic anatomy of the nasal cavity [19].

EES-DCR facilitates the accurate identification of the intranasal causes of DCR failures, such as adhesions, an enlarged middle turbinate, or an infected ethmoid sinus. EES-DCR plays a definitive role in failed external DCR and revision cases [20]. Most studies have reported good results and excellent patient acceptability [12].

Many surgeons prefer to operate under general anesthesia [7 21 22]. However, the procedure can also be performed under sedation and local anaesthesia [12 19]. To induce local vasoconstriction, a nasal tamponade in a mixture

Table I. Studies reporting results of external and endoscopic endonasal dacryocystorhinostomy.

Study	Year	Endonasal success	External success	Prospective/Retrospective	Comparative
Dolman [5]	2003	89.1%	90.2%	Retrospective	Yes
Zaidi [9]	2011	86%	100%	Prospective	Yes
Karim [7]	2011	93.2%	91%	Retrospective	Yes
David [23]	2000	100%	93.8%	Prospective	Yes
Saroy [12]	2010	90%	95%	Prospective	Yes
Harugop [24]	2008	93.3%		Prospective	No
Sinha [19]	2008	96%		Retrospective	No
Gupta [40]	2011	97%		Retrospective	No
Deviprasad [8]	2009	92%		Retrospective and prospective	No
Mikito [41]	2011		90.5%	Prospective	No
Preechawai [42]	2012	74.7%		Retrospective	No
Leong [43]	2010	86%	94%	Review	Yes
Sharma [44]	2008	88.5%	90.5%	Retrospective	Yes
Ben Simon [45]	2005	84%	70%	Retrospective	Yes
Cokkeser [46]	2000	88.2%	89.8%	Prospective	Yes
Agarwal [47]	2009	94%		Retrospective	No
Sonkhya [48]	2009	92%		Prospective	No

Table II. Studies reporting results of intraoperative use of mitomycin C in dacryocystorhinostomy.

Study	Year	EXT/EES	% Success MMC group	% Success control group	Randomized	Retrospective/ prospective	Comparative
Prasannaraj [35].	2010	EES	82.30%	85.70%	Yes	Prospective	Yes
Camara [39]	2000	EES	99.20%	89.60%	No	Retrospective	Yes
Gorgulu [49]	2012	EES	90%		No	Prospective	No
Penttila [38]	2011	EES	93%	60%	Yes	Prospective	Yes
Shine [17]	1997	EXT	100%	87.50%	No	Prospective	Yes
Yldrim [50]	2007	EXT	95%	60%	Yes	Prospective	Yes

of lidocaine and adrenaline at various concentrations (1:200,000, 1:100,000, 1:30,000, 1:10,000) is used [8 12 23]. The anaesthetic is administered before the starting procedure in accordance with the surgeon performing the procedure [12 21 23 24]. A 20-gauge vitrectomy light probe was introduced through the upper canaliculus until reaching the bony medial wall of the lacrimal sac and subsequently turned downward. A right-handed surgeon takes position on the right side of the patient for both right- and left-sided EES-DCR and directly views the transilluminated target area through a nasal speculum with 7.5-cm long blades and a fibre optic light carrier (Fig. 4) [21].

Ordinarily, a 0° nasal endoscope is used [23]; however, in cases of nasal septum deviation towards the obstructed side, a 30° nasal endoscope is preferred to enhance visualization of the lacrimal sac area, and the endoscope is negotiated gently beyond the point of maximum deviation [19]. A Freer periosteum elevator is used to incise the nasal mucosa using the light probe in the lacrimal sac as a guide. The incision was made vertically or in a curvilinear fashion down to the bone [21].

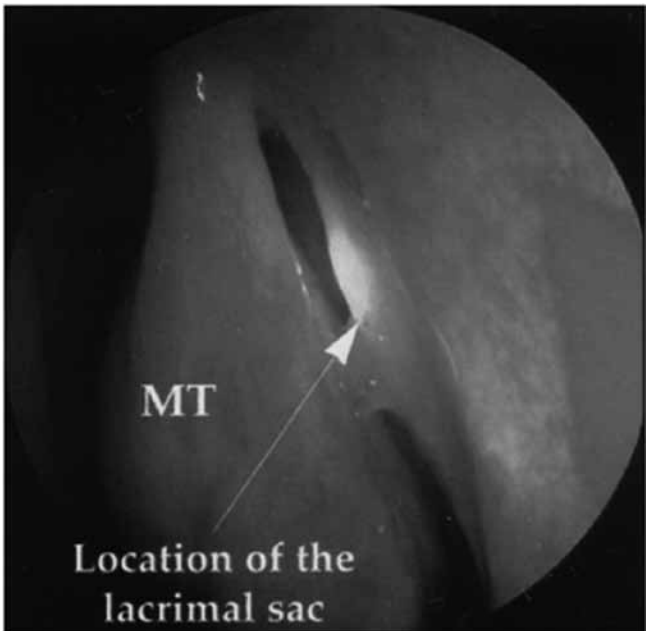

Fig. 4. A light probe introduced through the upper canaliculus. (MT: middle turbinate).

The incision line should extend above the anterior end of the middle turbinate, as the sac typically extends above the middle turbinate (Fig. 5). Restricting the incision to the anterior end of the middle turbinate can result in the incomplete exposure of the sac and compromise long-term results [12].

A variety of lasers with different wavelengths have recently been used to incise the mucosa, including high-powered blue argon, potassium titanyl phosphate and carbon dioxide. These lasers require safety precautions and generate char around the ostium site, requiring frequent lavage and debridement during the postoperative period [25-29].

Currently, most surgeons remove 1 to 1.5 cm of the nasal mucosa using Blakesley or Takahashi forceps [21]. Hajek's bone punch can also be used to remove the lacrimal bone. The thick region of the frontal process of the maxilla is drilled using a 3-mm burr to expose the entire medial wall of the lacrimal sac [8]. The tented medial wall of the sac is then removed. Once the sac wall is removed the lumen of the sac can be inspected.

When preserving the nasal submucosal injection in the presumed lacrimal fossa during opening of the sac, marsupialization can occur in the opposing nasal mucosa [7].

As in an open technique, a posterior based mucoperiosteal flap is created and positioned at the end of the procedure

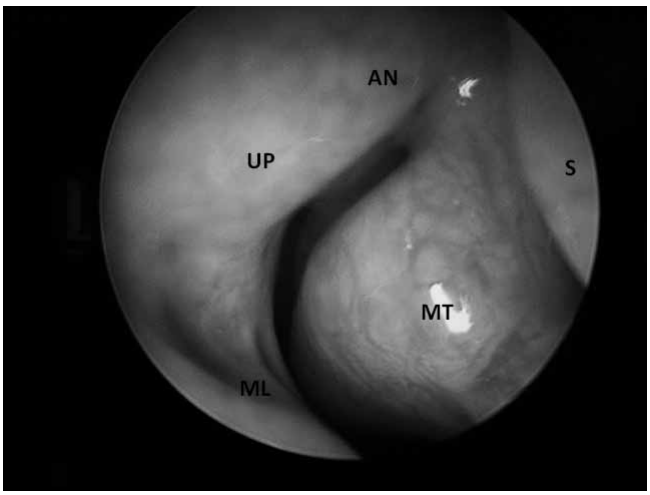

Fig. 5. The incision line above the anterior end of the middle turbinate. (AN: agger nasi, MT: middle turbinate, S: septum, PU: uncinate process, LM: maxillary line).

to keep the two mucosal layers in contact and ensure patency [30]. Some surgeons do not prefer to advocate creation of mucosal flaps at the bony window area to reduce the risk of postoperative fibrosis and obstruction [31]. Furthermore, the creation of mucosal and nasal flaps should not increase the success rate of EES-DCR [32].

Bicanalicular silicone tubes are introduced into both canaliculi and retrieved from the nasal cavity using a haemostat [21 33]. Nonetheless, some studies have reported good results without the need of nasolacrimal stenting [34].

There are few controlled trials in which MMC has been used as an adjunct to EES-DCR. MMC is generally applied using a cotton ball soaked in 0.2 mg/ml of solution and placed over the raw edges of the stoma for 10 min. The use of mitomycin does not influence the occurrence of granulations, synechiae, or obliterative sclerosis, and the success rate is not significantly altered [35-37].

However, other studies have suggested significant advantages in using MMC [38]. Camara conducted a study using 171 patients, of which 123 received adjuvant topical MMC intraoperatively in laser-assisted EES-DCR. These patients were observed for an average period of 51 months. The success rate was 99.2% when MMC was used and 89.6% when MMC was not used (Table II) [39].

Surgical outcomes

We compared various studies published in the last 15 years (1997-2012), and with respect to the definition of surgical success, we observed differences among the articles reviewed (Table I). There were no randomized studies in the literature.

The major outcomes used to define surgical success included subjective success based on the patient's symptoms and objective success based on assessment of the patency through syringing. In a retrospective study, Dolman reported [5] complete success in 90.2% of patients using EXT-DCR and in 89.1% patients using EES-DCR.

Complete success was considered when the tearing under normal conditions had been resolved, with no recurring infection and minimal or no reflex through the opposite canaliculus after lacrimal irrigation [5]. To our knowledge, Dolman's report is the largest combined EES-DCR and EX-DCR analysis, which included a sufficient number of subjects to demonstrate equivalent surgical outcomes between the two techniques.

In prospective studies, Zaidi [9] showed a 100% success rate for EXT-DCR and an 86% success rate for EES-DCR. Success was based on the degree of epiphora after 6 months and assessment of patency through syringing.

Others prospective studies [12] suggest comparable results for both procedures. Harugop [24] recorded a success rate of 93.3% in EES-DCR without intubation and 96% in EES-DCR with intubation, evaluating the degree of epiphora and the size of the rhinostomy.

Discussion and conclusions

External DCR remains the gold standard in terms of functional outcome in the treatment of nasolacrimal duct obstruction. In comparison, interest in the recently developed EES-DCR technique has been rekindled because of advances in instrumentation, notably the introduction of the rigid nasoendoscope, FESS and laser surgery. The advantages of external DCR include high predictability and the direct visualization of anatomy, which is highly relevant for sac tumours. This technique facilitates accurate anastomosis between the lacrimal sac and nasal mucosa. However, external DCR has some disadvantages, including facial scarring, lacrimal pump dysfunction resulting from the interruption of medial canthal anatomy and the orbicularis oculi muscles, and limitations in acute dacryocystitis patients with abscess formation.

An endoscopic approach reduces the risk of interfering with the medial canthal tendon and lacrimal pump physiology. This approach also reduces scarring, which is cosmetically important for certain patient groups, particularly young individuals. EES-DCR also has a shorter postoperative recovery time and reduced rates of postoperative complications, such as haemorrhage and cerebrospinal fluid rhinorrhoea. Serious complications, including orbital and subcutaneous emphysema, retrobulbar haemorrhage, medial rectus paresis and orbital fat herniation, are rarely observed in either form of DCR surgery.

An endoscopic approach facilitates diagnosis and management of the associated conditions, including septal deviation, sinus disease and turbinate hypertrophy.

Endoscopic endonasal DCR plays an established role in the revision DCR surgery. In the case of cicatricial obstruction at the osteotomy site, it is easier to perform endoscopic revision, and the patient is more likely to accept such a revision without visible external cuts.

Compared with external DCR, endoscopic DCR is more expensive, with high equipment costs. Endoscopic DCR is also technically more difficult to learn, and the learning curve for the endoscopic procedure has been reported in several studies.

However, it is difficult to compare the success rate for primary surgery between external DCR and endoscopic endonasal procedures, as there are few comparative studies. Few studies have standard outcome measures, with some defining success as patency to irrigation, whereas others have focused on symptom resolution. The results of EES-DCR are not as good as those with EX-DCR, presumably reflecting the fact that most surgeons traditionally create a smaller rhinostomy when performing an EES-DCR, although the use of this technique varies.

In the last 10 years, the differences in outcomes between the two techniques have been reduced because of advances in technology, and we affirm that the choice of the type of surgery is currently based on the experience of the surgeon, available resources and the patient preferences.

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