Evaluation of Endoscopic Dacrocystorhinostomy Using Microdrill with Creation of Mucosal Flaps

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Abstract

Purpose: To describe and assess the efficacy of endoscopic dacrocystorhinostomy using microdrill. This is a new technique that involves creation of a large rhinostomy and creation of mucosal flaps. The study involved a prospective nonrandomized interventional case series with short post-operative follow-up.

Methods: A prospective series of 30 consecutive endonasal DCRs. Patients included in the study had nasolacrimal duct obstruction and had not had previous lacrimal surgery. The technique involved formation of a large bony ostium and apposition of nasal mucosal and lacrimal sac flaps. Surgery was performed by two surgeons (Ophthalmologist/otorhinolaryngologist). Follow-up assessment included nasoendoscopy as well as symptom evaluation. Success was defined as anatomical patency with fluorescein flow on nasoendoscopy and patency to lacrimal syringing. The average follow-up time was 6 months (range 2-9 months).

Results: There were 30 DCRs performed on 30 patients (12 male, 18 female). The average age of the patients was 30 years (range 19-40 years). Common presentations were epiphora (95%) and/or mucocele (7%) and/or pyocele 3.3%. Septoplasty was required in 6 patients (20%). The surgery was anatomically successful in 28 cases (93.3%), but in 3 of them symptoms still present, so overall clinical success is present in 25 cases (83.3%).

Conclusion: Endonasal DCR involves creation of a large ostium using microdrill and mucosal preservation for the construction of flaps. The anatomical success is 93.3% and is better than external DCR. Creation of a large ostium as well as mucosal flaps improves the efficacy of this endonasal technique.

Key Words: Chronic dacryocystitis – Endoscopic dacrocystorhinostomy – Mucosal flaps – Microdrill.

Introduction

DACRYOCYSTORHINOSTOMY (DCR) is an operation that has been used for the past 100 years. The original intranasal approach was described in 1893 by Caldwell and the external approach in 1904 by Toti [1]. The external approach became very popular and the mainstay of treatment with modification in the 1920s with the addition of flaps, and in 1962 with silastic tube intubation by Jones [2]. The intranasal approach was largely abandoned owing to problems with visualization but with modern endoscopes and rhinology instruments there has been renewed interest in the past 10 or so years. McDonogh and Meiring [8] described the first modern endonasal DCR procedure in 1989 with Massaro et al. [4] in 1990 using an argon laser for the osteotomy. In 1991 Gonnering et al. [5] used an endoscope with the argon laser, rather than the operating microscope, for completing the endonasal procedure.

Many ophthalmologists still believe that external DCR is the gold standard treatment for nasolacrimal duct obstruction [6] with success rates of about 90% reported [7].

Currently endoscopic DCR can be performed with laser Assistance [8] or other methods to remove bone and mucosa including powered drills, punches, and radio surgical electrodes [9]. Laser assisted DCR (ENLDCR) has success rates which vary from 60% to 86%, whereas endonasal DCR with other tools (cold steel) seems to have a slightly higher success rate [9].

Most previous procedures involved sacrificing the nasal mucosa and removing the medial wall of
the sac. We describe an approach that involves preservation of nasal mucosa and the cutting of anterior and posterior flaps in the lacrimal sac in order to achieve apposition between lacrimal sac mucosa and nasal mucosa at the end of the procedure. The flaps are not sutured but closely apposed. This leads to the marsupialisation of the sac on the lateral nasal wall rather than creation of an ostium into the sac. To achieve lacrimal sac marsupialisation complete exposure of the sac is necessary. Until a recent publication the intranasal anatomy of the lacrimal sac was not fully understood [10]. The upper half of the sac lies above the insertion of the middle turbinate on the lateral nasal wall. This puts it behind the thick bone of the frontal process of the maxilla. To fully expose this area the use of a drill is necessary. Only the inferior posterior part of the sac is covered by the thin lacrimal bone [10].

Materials and Methods

Patients’ standard preoperative evaluations included investigation using lacrimal irrigation, Jones test and endoscopy of the nasal cavity.

It was possible to assess the need for concurrent septoplasty preoperatively. If the middle turbinate is not visible with the endoscope preoperatively owing to a septal deviation or spur then access is tight and DCR with septoplasty is needed. A large capacious nasal cavity with easy view of middle turbinate suggests DCR can be performed without septoplasty. Any lower lid problems or previous lacrimal trauma were exclusion criteria.

There were 30 patients who underwent endoscopic DCR procedures all using the same technique performed by two main surgeons (Ophthalmologist/otorhinolaryngologist). Twenty patients had a left DCR, ten a right DCR. There were 18 female and 12 male patients mean age was 30 years (range 19-40 years). Acute or chronic dacryocystitis was a feature in 14% of patients and mucocoele in 20%.

Six patients required Septoplasty, which was necessary to improve visualization to perform the DCR. Informed consent was obtained from all patients.

Surgical technique:

The operations were done under general anesthesia. The lateral nasal wall and head of the middle turbinate (MT) were injected with 1:100000 adrenaline. Endoscope with video camera was used for the entire operation, except when a septoplasty was required in which case the headlight was used. A mucosal flap, hinged posteriorly, was elevated from the lateral nasal wall to expose the frontal process of the maxilla and its articulation with the lacrimal bone. The incision for the mucosal flap begins 8 mm above the insertion of the middle turbinate and is brought horizontally forward 8 mm anterior to the middle turbinate. It is taken vertically down to just above the insertion of the inferior turbinate before taking it posteriorly up to the insertion of the uncinate process. The mucosal flap is elevated exposing the junction of the hard frontal process of the maxilla and the thin soft lacrimal bone. The lacrimal bone was peeled off the inferior half of the lacrimal sac. A biting punch was then used to remove the frontal process of the maxilla which overlies the anterior part of the inferior lacrimal sac. The bone over the superior nasolacrimal duct was also removed. Bone removal is continued superiorly till the bone becomes too thick for the punch. A long coarse diamond burr attached to microdrill is used to remove the rest of the frontal process of the maxilla still covering the anterior sac. This bony removal is continued superiorly above the attachment of the MT to remove bone that covers the fundus of the sac. The entire sac should be exposed. The medial wall of the sac is then tented with a Bowman’s probe to ensure all the bone over the common canalicular opening (CCO) has been removed. It is important to ensure that all bone over the CCO up to the fundus of the sac is removed, as this will allow the sac flaps to sit flatter on the lateral nasal wall. The medial wall of the sac is the incised vertically to create a large anterior and smaller posterior flap. Small horizontal cuts are made in these flaps superior and inferior so they can be reflected onto the lateral nasal wall without any tension. Once the lacrimal sac flaps have been positioned on the lateral nasal wall, the nasal mucosal flap is trimmed to fits around the opened lacrimal sac so that the mucosal edges are closely apposed.

The lacrimal system is then intubated and a small gel foam patch is used to keep the flap anastomosis in position for the initial healing period. Postoperatively, oral antibiotics for 5 days (amoxicillin and clavulanic acid 500/125 three times daily) and topical antibiotics (tobramycin drops) were given. A saline moisturizing spray was also used for 6 weeks to help stop mucosal drying in the acute postoperative period. Follow-up of patients was at 1, 3 and 6 months with the average follow-up being 6 months (2-9 months) after removal of tubes. Tubes were usually removed at the first postoperative visit at 4-8 weeks. Average
intubations time was 6 weeks (range 2-8 weeks). All patients underwent surgery with general anesthesia. After removal of tubes the patients were assessed with rigid nasal endoscopy and fluorescein dye passage. Morphological assessment of the ostium and syringing of the lacrimal system was also done. Patients were assessed in terms of anatomical patency (anatomical success) as well as symptom relief (clinical success).

Fig. (1) Shows the surgical technical steps and a postoperative view.

![Fig. (1): The detailed steps of endoscopic DCR.](image)

1- Submucosal injection of adrenaline 1/100000.
2- Mucosal incision using 3.2 mm curved microkeratome.
3- Removal of lower part of frontal process of maxilla using kerrison punch.
4- Removal of upper part of frontal frontal process of maxilla using diamond burr attached to microdrill.
5- Full exposure of the medial wall of the lacrimal sac.
6- Opening of the sac using 3.2 curved microkeratome.
7- Approximation of the anterior and posterior flaps. Silicone tube implanted.
8- Gel foam in place.
9- Post-operative follow-up (6 weeks).

**Results**

In the current study a well healed marsupialised ostium was seen in 28 of 30 cases (93.3%). There was free flow to the nose when one drop of 2% fluorescein was put in the conjunctival sac. The nasolacrimal system was also patent to syringing via the lacrimal puncta. In two of the 30 cases (6.7%) there was scarring of the ostium at the sac-nasal mucosal anastomosis visible on endoscopy. Neither fluorescein drainage nor lacrimal syringing was possible. These two patients had epiphora similar to their preoperative complaint. Three patients (10%) were symptomatic with a patent
system and a well healed ostium. One of these patients complained of epiphora preoperatively but was patent to syringing and two patients had anatomical nasolacrimal duct obstruction preoperatively. The overall success rate was then 83.3% (25 of 30 DCRs). All these three patients showed a well healed ostium on endoscopy but complained of occasional epiphora especially on windy days. In these patients fluorescein was seen to drain into the nose on endoscopy and lacrimal syringing was achieved without undue pressure generation. Hence the anatomical success rate was 28 of 30 case (93.3%).

Approximately 20% cases (6 of 30) required a septoplasty at the time of surgery. There were two cases of postoperative hemorrhage. These resolved with merocel nasal packing. This gives a rate of less about 6.7% which compares well with both previous endonasal studies and external DCR studies [29]. There was one case (3.3%) of orbital fat exposure which can occur if the dissection is taken too posteriorly into the uncinate. In all cases silicon tubes were used for lacrimal intubations. The average follow-up was 6 months (range 2-9). Follow-up of these patients is still ongoing.

Discussion

There has been concern over many years that endoscopic DCR is not as successful as external DCR [12]. There are very few prospective randomized trials in the literature. A study by Hartikainen et al. [7] in 1998 had a 1 year success rate of 75% for endonasal DCR as opposed to 91% for conventional external DCR. These investigators used non-laser tools to remove bone in the lacrimal fossa. Other investigators in the literature have used various lasers to create the rhinostomy.

Currently endonasal approaches can be divided into endonasal laser assisted DCR (ENLDCR), endocanalicular laser assisted DCR (ECLDCR), and powered mechanical endonasal DCR (MENDCR), or "cold steel" DCR, with [12] or without drills [13].

The present study has an anatomical success rate of 93.3%, with success strictly defined in both anatomical and symptomatic terms. Patients were assessed for fluorescein drainage to the nose when a drop was placed in the conjunctival sac. This has been shown to be a good, accurate test for functional performance of a patent DCR [14].

The main difference between the presented technique and previously described techniques is the creation of a large bony ostium and mucosal apposition with the creation of mucosal and lacrimal flaps. Since the early 1990s laser assisted DCR (ENLDCR) has grown in popularity but the long term success has not been high enough to convince many ophthalmologists to adopt the technique. The main problem with ENLDCR is the difficulty removing the thick bone of the frontal process of the maxilla. Most lasers can only create a 5-8 mm osteotomy as they are only removing the thin lacrimal bone at the posterior inferior aspect of the lacrimal sac. Even though some authors [15] have suggested ostium size is unimportant we believe this is not the case. The creation of a large ostium allows the room to fashion an Anastomosis of the lacrimal mucosa with the mucosa of the nasal cavity.

Anatomical studies [10] have shown that the lacrimal sac is lateral to the head of the middle turbinate superiorly and its antero-inferior aspect is under the frontal process of the maxilla (other investigators have placed the sac lower on the lateral nasal wall) [16]. Both these areas have very thick bone that is not amenable to removal by laser or rongeurs. If an attempt is made to remove this thick bone with a laser excessive heat is generated which may increase tissue damage and postoperative scarring. This may be one of the reasons for the decreased long term success of ENLDCR and ECLDCR [17].

The technique described in this study uses simple punches and a diamond burr attached to microdrill to remove all the bone covering the lacrimal sac and upper part of the nasolacrimal duct creating an osteotomy of around 20mm X 15 mm. This is a much larger removal of bone than seen in other endonasal approaches. The large osteotomy allows wide exposure of the lacrimal sac and allows the creation of mucosal flaps, which replicates nasal and sac mucosal apposition seen with external DCRs. A large ostium at the time of surgery correlates with a large opening intranasally postoperatively [18].

It is important to note that much of the sac lies above the level of the maxilla of the middle turbinate, contrary to other authors suggesting that the sac is anterior to or below the insertion of the middle turbinate with little extension above it [16]. The bone covering this superior part of the sac is very thick and has an intimate relation with the agn nasi cell medially. In addition, it is important to recognize that the posterior aspect of the lacrimal sac is adjacent to the uncinate [19], and that this structure should be preserved. Going posterior to this landmark leads to an increased risk of orbital
fat prolapse or haematoma in addition to compromising the natural ostium of the maxillary sinus [20]. It has been suggested that the uncinectomy needs to be done as the first step to endonasal DCR [21]. This is not necessary as the frontal process of the maxilla is a constant intranasal landmark that abuts the thin lacrimal bone below the insertion of the middle turbinate into the lateral nasal wall. The junction of the hard frontal process of the maxilla and the thin lacrimal bone is the first landmark that is sought during the presented technique but it can only be visualized with a 30 degree endoscope in the majority of patients. The uncinate process is in a posterior relation to the lacrimal bone and as such does not need removal to expose the lacrimal sac.

To fully expose the sac the thick bone of the frontal process of the maxilla needs to be removed, as does the bone superior to the lacrimal bone. This often necessitates removal of the antero-lateral wall of the maxilla. Once the sac is opened the common canicular opening is used as a landmark to ensure adequate exposure of the sac. It is important to open the lacrimal sac with "cold steel" to avoid risks of contracture and scarring [22]. The creation of anterior and posterior flaps in the lacrimal sac mucosa allows primary intention healing with the nasal mucosal flaps, thus marsupialising the sac into the lateral nasal wall. Poor or minimal preservation of mucosa may lead to increased granulation and fibrosis [23]. This approach preserves the general principles of creating a mucosal lined fistula so important in external DCR surgery. Postoperative scarring at the site of the rhinostomy is one of the major causes of DCR failure, both with external and ENLD-DCR techniques [24].

In our current study two patients had scarring of the osteotomy that led to failure of the surgery. Several studies [25] have suggested that a dependent ostium position is vital to increase success in external and endonasal surgery. Complete exposure and marsupialisation of the sac with adequate bone removal obviates concern about ostium position that may occur with other techniques.

Recently several investigators [26] have used mitomycin C to improve success rates with ENLDCR and success rates seem close to 100% [27]. If the whole of the lacrimal sac is not exposed and the rhinostomy is small this may have a role in preventing closure of the ostium.

Many investigators use a light pipe inserted through the canaliculi to identify the intranasal position of the sac. During our study septoplasty to improve access to the maxilla of the middle turbinate was necessary in 20% of cases. It is important that the ophthalmologist train in this area before attempting this technique. This percentage relates to the increased access needed with this approach. Only minimal access is needed in ENLDCR to remove the lacrimal bone. An additional advantage of our technique was the preservation of lacrimal pump function. The attachments of the orbicularis to the lateral wall of the lacrimal sac are not disturbed with this approach and this may help preserve some lacrimal pump function.

Conclusions:

For the past decade many types of endonasal approaches have been tried. Generally the long term success rates have not been equivalent to that achieved with external DCR. The technique we describe encompasses important differences to previously described methods. It involves creation of a large rhinostomy and the preservation of lacrimal sac and nasal mucosa to create mucosal flaps. This mucosal preservation and apposition help to marsupialise the lacrimal sac onto the lateral nasal wall. Good anatomical knowledge of intranasal structures allows accurate mucosa preserving surgery. Endoscopic skills are necessary to ensure accurate and reproducible surgery. The technique described has a clinical success rate of 83.3% and the anatomical success rate is 93.3%. These results are superior to those obtained for both external DCR as well as for other endonasal approaches.

References

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