Minimally Invasive Surgery of Lachrymal Outflow: Comparison of Techniques with Presentation of a Novel Surgical Dacryocystectomy Variant

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Abstract

Objective: The surgical treatment of epiphora and dacryocystitis includes Dacryocystorhinostomy (DCR) and Dacryocystectomy (DCT). To date, dacryocystectomy has been considered a secondary procedure and is not properly considered among the currently available surgical options. Intubation of the lacrimal system often improves surgical outcomes. In this study, a new variant of surgical technique, dacryocystectomy with lacrimal canalicula silicone intubation, is presented. All novel aspects and possible indications are discussed.

Methods: Patients with chronic dacryocystitis associated with epiphora and lacrimal stenosis were enrolled for dacryocystectomy with silicone intubation. During follow-up, prevalence of epiphora, disease recurrences and adverse events have been investigated. Also, a retrospective clinical charts comparison with patients that received dacryocystorhinostomy ab externo has been performed.

Results: No significant differences were found in terms of postoperative epiphora, silicon tube dislocation and overall adverse events have been observed between the compared groups (p>0.1). Persistent bleeding events were significantly more frequent in the DCR group (p<0.05). No severe adverse events were observed in both groups.

Conclusions: Lacrimal intubation may improve classical dacryocystectomy outcomes with greater reduction of overall adverse events. This technique, when well indicated (especially following a proper intraoperative clinical evaluation), may provide a decisive resolution of infective/inflammatory lacrimal affections and can avoid intra and postoperative complications associated with DCR.

Keywords: Dacryocystectomy; Lacrimal intubation; Dacryocystorhinostomy; Surgical technique; Epiphora; Dacryocystitis; Crawford tubes

Abbreviations: DCR: Dacryocystorhinostomy; DCT: Dacryocystectomy

Introduction

The surgical treatment of epiphora and dacryocystitis includes dacryocystorhinostomy (DCR), performed with transcutaneous (external DCR) or endonasal technique, and removal of the lacrimal sac (dacryocystectomy, DCT).

Dacryocystectomy has been considered a secondary procedure, thus it is rarely mentioned in recent literature and not properly considered among the currently available surgical options. The main indication of DCT is limited to cases of lacrimal sac tumors [1]. Other indications reported in the Literature include recurrent dacryocystitis, especially in cases of fragile patients, nasal or facial malformations increasing the risk of post-DCR cutaneous fistula, Wegener granulomatosis or other vasculitis, risk of excessive bleeding, patients not suitable for long surgical procedures or with a low pain threshold [2]. Since the indication to DCT is considered rare, many surgeons are not experienced with this technique.

Given that, dacryocystectomy deserves to be reconsidered, especially in case of fragile patients or pre/intraoperative findings suggestive for lacrimal sac abnormalities or infections (which can be properly assessable only in course of intervention with surgical microscopy). Moreover, there are reports of cases of frail and elderly patients where a dacryocystectomy was preferred to DCR [3-5].

Usually, after a dacryocystorhinostomy, lacrimal intubation is required in order to improve postoperative outcomes [5-7]. However, Crawford's tube removal can often lead to DCR failure with epiphora recurrence and local inflammation that can propagate from the nasal region with ascending behavior. In addition, in patients with lacrimal outflow stenosis, DCR alone doesn't always restore a sustained reopening. The decision to apply stent intubation should be performed on the basis of pre/intraoperative findings [6].

In this study, a new variant of surgical intervention, dacryocystectomy with lacrimal canalicula intubation, is presented. All novel aspects and possible indications are discussed (also in comparison with dacryocystorhinostomy). This technique has been performed under surgical microscopy, in order to better observe the presence of anatomical conditions of chronic flogosis or signs of infection.
Methods

This novel surgical variant has been dedicated to patients presenting at our center with recurrent/chronic dacryocystitis associated with epiphora or lacrimal stenosis and indication to surgical resolution. Exclusion criteria were ongoing/unresolved severe corneal surface disease/infection, previous lacrimal surgery, maxillofacial malformations, acute ongoing lacrimal infection, pregnancy. All procedures were performed in conformity with the ethical principles set out in the Helsinki Declaration and its revisions. Consent to surgery was obtained in written form and has been registered for all subjects of this study. All subjects under study agreed to receive Dacryocystectomy with intubation instead of DCR, when proposed, since they intended to resolve recurrent dacryocystitis or they were against a more invasive procedure with higher anesthesiologic risk.

Dacryocystectomy with lacrimal intubation has then been performed by the same surgeon with the aid of a surgical microscope with a focal length of 300 mm, as reported below:

**Skin disinfection with iodopovidone:**
- “Medicated” lacrimal irrigation through superior and inferior puncta, with a tobramycin/dexamethasone association, preceded by assessment of mucopurulent secretions presence;
- Anesthesia with subcutaneous and peribulbar infiltration of mepivacaine 2%+epinephrine 1:100.000 (Carbocaine);
- Cutaneous incision of 10-12 mm at 3-4 mm from the inner canthus along the anterior lacrimal crest;
- Intraoperative assessment of anatomic relationships and conditions of the lacrimal sac;
- Assessment of bone conditions, focusing on alignment/distance with the lacrimal sac;
- Canalicular incision at the level of their entrance in the lacrimal sac or at the level of the distal portion of the common canaliculus;
- Removal of the lacrimal sac (after a H-shaped incision, preferred when possible in relation to lacrimal sac conditions found through surgical exploration);
- Irrigation of the lacrimal pathways with Cefuroxime (50 mg/0.5 ml) and betamethasone (4 mg/2 ml);
- Intubation of the superior and inferior lacrimal canaliculi with Crawford tube: the two metal bodkins at the ends of the Crawford tube were introduced in both lacrimal puncta and pulled at the level of the respective canalicular distal ends. Then, both metal bodkins were removed and the remaining distal ends were shortened in order to obtain an intraorbital intubation of 10 mm of length.
- Knotting of the two Crawford tubes distal heads with suture/anchorage on anterior endorbital portion, with prolene 6-0 thread;
- Placement of the free endorbital portion of the Crawford tubes after realization of a proper deep posterior endorbital space. The endorbital lodge has been created within the lacrimal fossa (medially to the posterior lacrimal crest) through posterior mucosa disconnection, diathermy and cauterization directed towards the ethmoidal region.
- Repeated irrigation with cefuroxime (50 mg/0.5 ml) and betamethasone (4 mg/2 ml)
- Intradermal suture of the nasal cutaneous surgical wound with nylon 6-0 or prolene 6-0 thread;
- Crawford tube excision with scissors at the level of lacrimal puncta (to prevent extrusion) followed by suture of the proximal portion on lacrimal puncta with Sharpont™ nylon microsuture (nylon 10-0)
- Following surgery, each patient received netilmicin+dexamethasone eyedrops 4 times daily in the treated eye (to be applied at the inner canthus), and heparin sodium 500,000 UI/100 ml eyedrops (in order to prevent intraluminal coagulation of the tubes), twice a day, for a total of 15 days. Each patient also applied an Ofloxacin 0.3% ointment, 3 times a day on the skin wound for 15 days.
- The suture applied to the skin wound was removed at 10 days after surgery. Sharpont™ Nylont suture (nylon 10-0) was removed 10-15 days after surgery depending on different cases. No postoperative lacrimal ducts irrigation has been performed.

Primary outcomes were prevalence of postoperative epiphora or lacrimal infection (dacryocystitis) and prevalence of local/systemic adverse events. Preliminary results have been confronted with a retrospective clinical charts review of patients that received dacryocystorhinostomy *ab extra* at our center in the previous year, which have been selected applying the same indications and exclusion criteria of patients enrolled in this study, in order to obtain a homogeneous confront group (in relation to age, sex and pathologies). Clinical charts with missing information about one or more postoperative outcomes have not been included. Comparison between the two groups have been performed with Fisher Exact Test.

Results

39 patients were recruited in this study to undergo dacryocystectomy with lacrimal intubation technique. Population characteristics are reported in Table 1. 32 clinical charts of patients that received dacryocystorhinostomy in the previous year have been included. Characteristics of the retrospective clinical chart review are reported in Table 2. No statistically significant differences between the characteristics of the groups under study were found. Postoperative clinical presentation is shown in Figure 1.

<table>
<thead>
<tr>
<th>Participants characteristics</th>
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<tbody>
<tr>
<td>Patients</td>
<td>Men</td>
<td>10 (26.09%)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>29 (73.91%)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>39</td>
</tr>
<tr>
<td>Age</td>
<td>Range</td>
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<tr>
<td></td>
<td>Patients &gt;80 years old</td>
<td>12 (30.43%)</td>
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<tr>
<td></td>
<td>Patients &gt;75 years old</td>
<td>9 (21.74%)</td>
</tr>
<tr>
<td>Principal disease</td>
<td>Recurrent dacryocystitis</td>
<td>39 (100%)</td>
</tr>
<tr>
<td></td>
<td>Lachrymal stenosis</td>
<td>22 (56.41%)</td>
</tr>
<tr>
<td></td>
<td>Epiphora</td>
<td>39 (100%)</td>
</tr>
<tr>
<td>Associated Diseases</td>
<td>Blood hypertension</td>
<td>24 (60.87%)</td>
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Hyschemic cardiopathy
Pacemaker holder

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<th>In therapy with oral antiaggregant</th>
<th>10 (26.09%)</th>
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<tr>
<td>In therapy with oral anticoagulants</td>
<td>5 (13.04%)</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>2 (4.35%)</td>
</tr>
<tr>
<td>Benign Prostatic hypertrophia</td>
<td>5 (13.04%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>15 (39.13%)</td>
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Table 1: Population characteristics of the dacryocystectomy with intubation group.

Dacryocystectomy group

14 patients (36.84%) reported the persistence of the epiphora, which lasted for not more than 30 days after surgery and coincided mostly with eyedrops administration. Of these patients, 10 (26.31%) complained occasional lacrimation even at the six months follow-up, albeit markedly reduced if compared to the immediate post-operative.

In the event of dacryocystitis or subacute flogosis before surgery, no recurrence was observed throughout postoperative follow-up and patients reported complete symptoms resolution.

Recorded adverse events have been reported:

- Epithelial corneal erosion for protrusion from the canalicula of a single Crawford tube (8 cases, 21.05%), that has been subsequently shortened to the slit lamp;
- A complete, post-traumatic, Crawford tube extrusion case (2.56% of operated patients), then repositioned;
- A mildly local bleeding case persisting for 15 days.

Dacryocystorhinostomy group: clinical chart analysis

In this group, 9 patients (28.13%) reported epiphora persisting for more than 30 days after surgery. At the 6-months follow-up 4 patients (12.5%) keep complaining about occasional lacrimation, even if reduced.

Recorded adverse events in this group were:

- 4 cases of tube protrusions (12.5%)
- 2 Crawford tube extrusions (6.25%)
- 7 cases of persistent bleeding (21.86%)

2 cases of dry eye (6.25%)
1 case of pyogenic granuloma (3.13%)

Comparison with retrospective clinical chart analysis

Regarding persistent epiphora after 30 days, no statistically significant differences were found (p>0.1). Even in the long term no differences in epiphora episodes were found (p>0.1).

Regarding overall non-severe adverse events we have found differences statistically significant (p<0.01). No differences were found in case of tube protrusion (p=0.53) or extrusion events (p=0.59). Persistent bleeding events were significantly fewer in the DCT group (p<0.05). No severe adverse events were observed in both groups.

Table 2: Patients characteristics of the externa dacryocystorhinostomy group (exracted from retrospective clinical charts analysis.

Discussion

If compared to DCR, dacryocystectomy has advantages in terms of technical easiness, lower learning curve, rapid execution in local anesthesia, less invasiveness (since bone or nasal mucosa rupture is not needed), minimal bleeding, lower hospitalization, early recovery, and overall minor morbidity. Before the execution of dacryocystectomy
with silicone intubation, patients were informed that the purpose of this procedure was to eliminate recurring inflammation with excessive lacrimation. Infectious sites can be completely removed with the asportation of the lacrimal sac. A reduction of epiphora have been observed and no significant differences were found between the DCT group and the DCR interventions analyzed. Improvement of epiphora after this DCT technique may accrue probably from the realization of an alternative lacrimal outflow at the level of the posterosmedial orbital region (with diffusion mechanism into the orbital venous drainage), which is facilitated by the application of silicone intubation with intraorbital suture (using in our cases the 10-0 nylon Sharpoint’). Consequently, a reduction of the nasal lacrimal drainage can occur (due to complete lacrimal sac removal) with a following increase of lacrimal meniscus (even if not clinically significant). Besides, if lacrimal sac infection or flogosis is found during the pre/intraoperative evaluation, the resolution of these conditions should be prioritized with respect to the resolution of epiphora. In these cases, techniques performing a complete sac removal should be privileged even when patients complain mainly about epiphora. In addition, several subjects reporting residual epiphora after surgery referred a complete resolution after eyedrops suspension at the end of postoperative treatment (the optimal post-surgical efficacy occurred after eyedrops suspension).

The ostectomy in DCR surgery, may also promote nasal absorption of antiglaucomatous drugs, increasing the risk of systemic side effects. Toxicity of topic beta-blockers may be significantly aggravated after an effective DCR due to an increase in lacrimal outflow through the anastomotic site with increased drug absorption at the level of the nasal mucosa [18]. We therefore believe that DCT may be preferred to DCR in the management of dacryocystitis episodes in elderly patients receiving topical beta blockers, when epiphora is not a serious symptom. The execution of a DCT instead of DCR also prevents the "sump syndrome" that can occur after DCR due to an incomplete anastomosis or to lacrimal sac regeneration.

Given these considerations, the choice between DCR or DCT may be influenced also by the different conditions assessed intraoperatively: repeated infectious events of the lacrimal sac (which may appear inconsistent) or mucopurulent discharge at the time of intraoperative irrigation, can lead the surgeon choice towards a dacryocystectomy with intubation procedure.

The "lacrimal plug" effect (following the reduction of the nasal lacrimal drainage) is particularly desirable in patients with different degrees of dry eye because it increases lacrimal meniscus improving keratoconjunctivitis sicca or tear hyposecretion [2]. In fact, Boynton and Anawis commented that elderly patients with dry eye, DCR can lead to discomfort, even when technically correct, because these subjects have insufficient production of tears to maintain the lacrimal flow and the nasal drainage is more represented [19]. Even in this study, dry-eye onset after dacryocystorhinostomy has been observed.

Crawford tube prolapse is one of the most common complications when silicone intubation is applied, especially after DCR. Crawford tube prolapse is one of the most common complications when silicone intubation is applied, especially after DCR. [20]. The lateral prolapse of the tube is problematic given the potential corneal and conjunctival irritation, puntal erosion and patient discomfort [21]. Crawford tube’s intraorbital anchorage is a safe procedure as it would limit the anterior dislocation and the risk of ocular extrinsic muscles involvement is low. The suture on the lacrimal puncta 10-0 nylon (with Sharpoint™ needle) has the advantage of maintaining endonasalicular positioning (supporting the endorbital suture). However, Crawford's tube prolapse is still possible. The passage of the nylon thread inside the tube lumen avoids its occlusion by debris or mucous swelling. We did not observed cases of stenosis/scarring of the lacrimal puncta following suture.

In this particular DCT technique, postoperative lacrimal irrigations or probing have never been performed, in contrast with regular DCR procedures. On the contrary these maneuvers should be contraindicated after this type of surgery and may lead to failure or
possible complications. No inflammatory granulomas have been observed in the postoperative follow-up.

Conclusions

Silicon lacrimal intubation may improve classical dacryocystectomy outcomes with greater reduction of the epiphora. This modified technique can expand the indications of DCT which can therefore be dedicated to cases of recurrent dacryocystitis (associated with dry-eye syndrome), frail subjects with high hemorrhage risk or affected by generalized vasculopathy or uncontrolled hypertension, subjects with conditions leading to ocular/nasal scarring or ascending infectious processes, subjects treated with antiangiomatic drugs (in order to prevent systemic toxicity), patients presenting maxillofacial pyomucocoele or malformations (even in case of previous surgery) and intraoperative assessments which lead to conversion from DCR to DCT (these should be obtained only under examination through operative microscopy) [22-26]. Since this modified DCT is also effective in treating "sticky eye" symptoms, it may be preferable to DCR especially for older patients complaining mainly mucopurulent discharges and episodes of dacryocystitis rather than "watery-eye".

DCT with intubation, when well indicated, may provide a decisive resolution of infective/inflammatory affections (acute/subacute/recurrent) of the lacrimal sac and can avoid intra- and postoperative complications associated with DCR. While DCR remains the operation of choice for the vast majority of lacrimal disorders, when the only symptom is epiphora, the DCT with intubation should still be carefully considered, especially if based on clinical findings in the intraoperative setting. In addition, as the surgical time is significantly shorter, the intraoperative hemorrhage can be minimized, and the time of local anesthesia needed is safer than in the DCR, DCT may be considered in case of frail patients.

In conclusion, DCT with intubation of lacrimal canaliculi can represent a safe alternative to DCR, particularly in frail, elderly patients with recurrent or chronic dacryocystitis or alterations of the lacrimal sac and/or the anatomical configuration of the medial orbit. This technique should be considered also in case of intraoperative assessment of alterations that can lead to dacryocystorhinostomy failure. Moreover, we have recently designed a minimally invasive intraorbital lacrimal prosthesis (currently patent pending) which can be associated with the procedure described in this study.

Conflicts of Interests

The authors declare that they have no competing interests.

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