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CLINICAL RESEARCH

Endoscopic Radiofrequency-Assisted Dacryocystorhinostomy with Double Stent: A Personal Experience

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ABSTRACT Aim: To report the success rate of endoscopic radiofrequency-assisted dacryocystorhinostomy with double stent and the use of a Griffiths collar button. Method: A prospective, single surgeon, uncontrolled, interventional case series study was designed to include 112 patients with nasolacrimal duct obstruction. Endoscopic radiofrequency-assisted dacryocystorhinostomy (ERA-DCR) with insertion of a Griffiths collar button was done on 102 patients with unilateral nasolacrimal duct obstruction and 10 patients with bilateral nasolacrimal duct obstruction. The operation was defined as a success if: a) preoperative epiphora was resolved; b) nasolacrimal patency was achieved as confirmed by lacrimal irrigation as well as by endoscopic observation of fluorescein dye flowing through the surgical ostium on lacrimal irrigation. *Results*: A total of 122 ERA-DCR procedures was done, of which 117 procedures involved cases of primary acquired nasolacrimal duct obstruction (PANDO) and five procedures involved cases of previously failed endonasal DCR. Two failures were observed in this study out of the 117 procedures done on PANDO cases. The success rate is computed at 98% (115/117). The postoperative follow-up period was 28.08 ± 14.7 months. *Conclusion*: Endoscopic radiofrequency-assisted dacryocystorhinostomy with double stent and the use of a Griffiths collar button shows a success rate of 98% in the long-term patency of the intranasal ostium.

KEYWORDS Nasolacrimal fistula; nasolacrimal duct obstruction; dacryocystorhinostomy; endoscopic radiofrequency-assisted DCR (ERA-DCR); silicone stents; mitomycin; Griffiths collar button

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INTRODUCTION

Dacryocystorhinostomy (DCR) is a drainage procedure designed to bypass the site of nasolacrimal duct obstruction by forming a fistula between the lacrimal sac and the nasal cavity. Intranasal DCR was first described by

Caldwell in 1893 (Hartikainen et al., 1998). This approach did not immediately gain its present popularity, due mainly to the difficulties in visualizing the intranasal anatomy. In 1989, McDonogh and Meiring described endoscopic transnasal DCR (Sprekelsen and Baberan, 1996).

The introduction of rigid 0° and 30° angled nasal endoscopes, such as the Karl Storz endoscope, has greatly improved the visualization of the intranasal cavity (Shun-Shin and Thurairajan, 1997). Lasers have also been described as a useful tool in endonasal DCR (Hehar et al., 1997). However, most early studies of laser-assisted and nonlaser-assisted DCR reported lower success rates between 63% and 82% (Boush et al., 1994; Kong et al., 1994; Sadiq and Ohrlich, 1997; Hartikainen et al., 1998). In 1995, Javate et al. (1995) described a technique for intranasal DCR, which they called the ERA-DCR (Endoscopic Radiofrequency-Assisted DCR), using simple instruments such as a curette, Kerrison punch, freer elevator, Karl Storz endoscope (Karl Storz GmbH and Co., Tuttlingen, Germany), an Ellman radiofrequency unit (Ellman International Inc., Hewlett, NY) and the Javate DCR electrodes (Fig. 1) which the author designed for this innovation. He first reported the use of the radiofrequency unit in endonasal DCR in 1995, yielding a success rate of 90% (Javate et al., 1995). Since then, a modification of the original technique for ERA DCR has been made, with the addition of a Griffiths collar button (Javate and Pamintuan, 1998) (Becton Dickinson-Visitec Products; Sarasota, FL). The purpose of this article is to report the authors' personal experience with endoscopic radiofrequency assisted DCR with the Griffiths collar button.

MATERIAL AND METHODS

Since January 1997, ERA-DCRs have been performed in patients diagnosed as having primary acquired nasolacrimal duct obstruction. All patients underwent complete preoperative ophthalmic evaluation, including slitlamp examination and assessment of eyelid position and tone. Nasolacrimal duct obstruction was documented by Jones I and Jones II dye tests, the dye disappearance test, Schirmer I and/or basic secretion tests, lacrimal probing and irrigation. Dacryocystography was performed in selected patients as well. Preoperative nasal endoscopy was performed to identify any preexisting intranasal pathology such as middle turbinate hypertrophy, septal deviation or nasal polyps which could affect intranasal access to the lacrimal sac. Exclusion criteria were canalicular or common canalicular obstruction as ascertained by probing, noticeable lower lid laxity, suspicion of malignancy, radiation therapy, post-traumatic bony deformity and bone diseases. All patients gave their informed consent prior to surgery.

The operation was performed under general anesthesia or with local anesthesia and monitored intravenous sedation. Surgery was performed with the Ellman Surgitron unit with a power setting of 9 using the

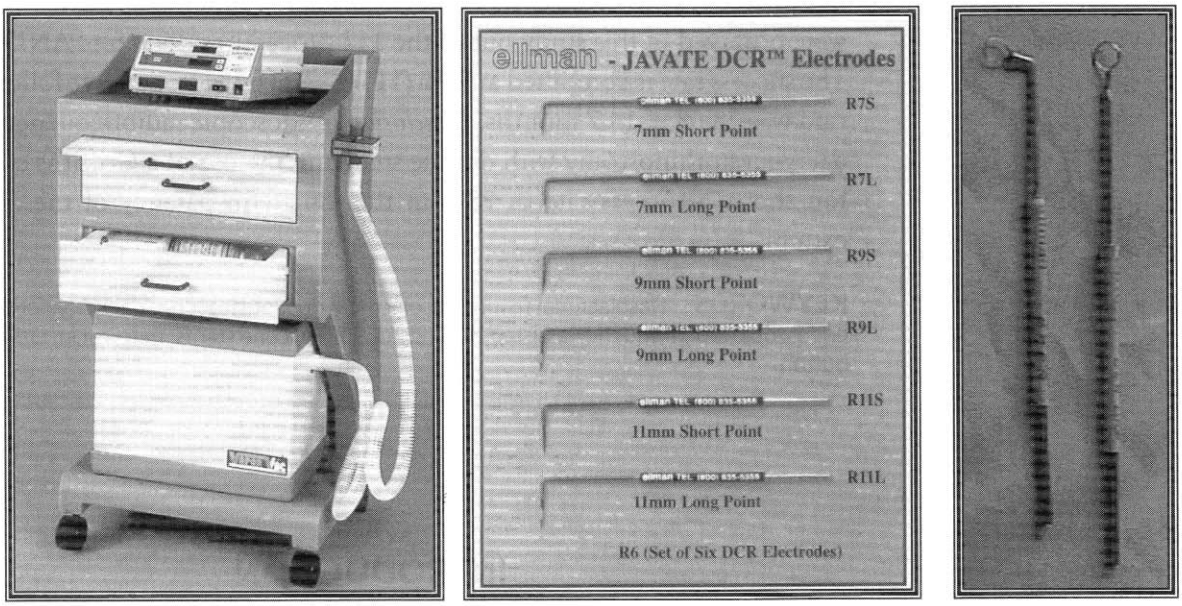

FIGURE 1 Ellman Radiofrequency Unit, Javate DCR Electrodes, and loop electrodes.

coagulation mode. The patient was placed in a supine position with the head slightly elevated to decrease venous pressure at the operative site.

After spraying the nasal mucosa with lidocaine 4% nasal spray, the mucosa of the ipsilateral nostril was initially vasoconstricted with nasal packs of cotton pledgets soaked in 0.05% oxymetazoline hydrochloride. For patients who underwent local anesthesia and monitored intravenous sedation, regional nerve block anesthesia (anterior ethmoidal and infraorbital) was then performed using a local anesthetic mixture of 2% lidocaine with a 1:100,000 dilution of epinephrine and 0.75% bupivacaine hydrochloride, with hyaluronidase. A 20-G retinal light pipe lubricated with antibiotic ointment was then inserted through the dilated superior canaliculus to ensure placement of the tip at the most inferodependent portion of the lacrimal sac possible. A 0 degree and/or 30 degrees rigid Karl Storz endoscope was introduced into the nose to allow visualization of the area anterior to the middle nasal turbinate via a video camera. Once the tip of the light pipe was adequately positioned at the posteroinferior wall of the sac, the light pipe was held in place using sterile tape.

The light from the endoscope was kept at its minimum setting to allow better visualization of the illumination from the retinal light pipe. A diffuse glow indicated inadequate apposition of the light pipe to the lacrimal bone. A discrete area of light indicated the intended area of rhinostomy. The overlying mucosa was injected with the lidocaine-bupivacaine-ephinephrine solution under endoscopic control. A 12-mm area of this nasal mucosa was then incised using an assortment of electrode points of varying lengths (Ellman-Javate DCR electrodes) connected to an Ellman Surgitron unit. The incised mucosa was then lifted off with a Freer periosteal elevator. Lately, we have switched from a straight electrode to a loop electrode, scraping the nasal mucosa which facilitates this step of the procedure. A curette was used to make an initial puncture into the site of intended rhinostomy and the ostium was enlarged to 8–10 mm using a Kerrison punch. The rhinostomy included part of the frontal process of the maxilla (anterior lacrimal crest). The posterior inferior and anterior inferior walls of the lacrimal sac were incised with the Ellman-Javate DCR electrodes aided by the indentation of the sac wall using a Javate lacrimal indentation probe to ensure a 5–10 mm opening. Any lacrimal sac that was difficult to visualize (because of cicatrization, for example) was dilated with Aquagel introduced through the canaliculus. This is to avoid injury to the common canaliculus during incision. The shorter DCR electrodes are used for normal or enlarged lacrimal sacs, whereas the longer electrodes are necessary to reach the cicatrized lacrimal sacs. Additional marginal sac tissue was removed with a Blakesley nasal forceps. The use of the Ellman-Javate DCR electrodes and the Blakesley nasal forceps allows direct visualization and biopsy of the lacrimal sac, which is not possible in those cases undergoing laser DCR.

Once the nasal mucosa, rhinostomy, and lacrimal sac openings were deemed to be of adequate size, the mucosa underlying this area was then treated with cotton balls soaked in a 0.5 mg/ml solution of mitomycin applied for 3 minutes with the purpose of inhibiting fibroblastic proliferation. Residual mitomycin was copiously irrigated from the operative site and nasal cavity with sterile normal saline.

Bicanalicular intubation of the nasolacrimal fistula was then completed using a Visitec modified 5013 lacrimal intubation set with a retriever device to bring out the tubes to the external naris. The Griffiths collar button was placed over the probes of the canalicular tubes, pushed superiorly through the nostril, and brought to the bony opening using alligator forceps (Fig. 2). The tubes were then tied into two square knots, further secured by a 5–0 silk suture, and cut to an

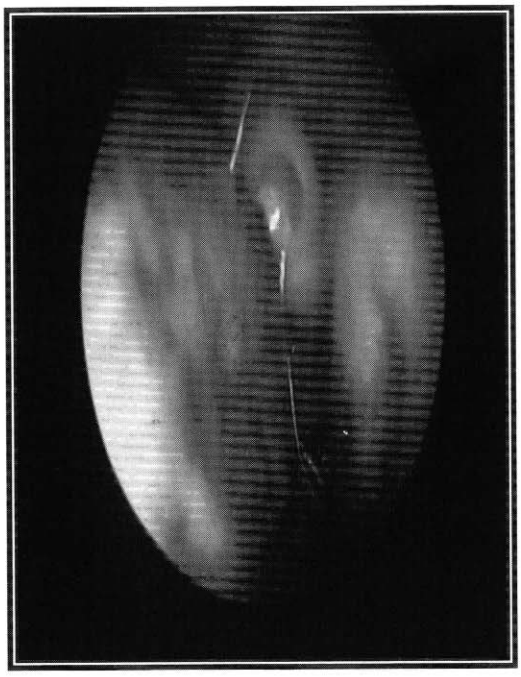

FIGURE 2 **Endoscopic photograph showing silicone tubing emerging from the central lumen of the Griffiths collar button.**

appropriate length within the nose. Patency of the fistula was then confirmed via lacrimal irrigation around the silicone stent under endoscopic visualization.

Postoperative medication included ofloxacin (Inoflox; Santen Pharmaceutical Co., Ltd. Osaka, Japan) ophthalmic solution applied topically four times daily, and nasal saline irrigation three times daily followed by nasal spraying with fluticasone propionate, starting on the first postoperative week and between the first, second and third postoperative weeks for lacrimal irrigation and removal of nasal debris, performed endoscopically. Subsequent follow-up visits were at intervals of 1–2 weeks. The Griffiths collar button was removed 2–3 months postoperatively. Silicone tubes were removed 3–6 months postoperatively (Fig. 3). Postoperative ostium patency was assessed by lacrimal irrigation as well as by endoscopic observation of fluorescein dye flowing through the surgical ostium on lacrimal irrigation (Fig. 4).

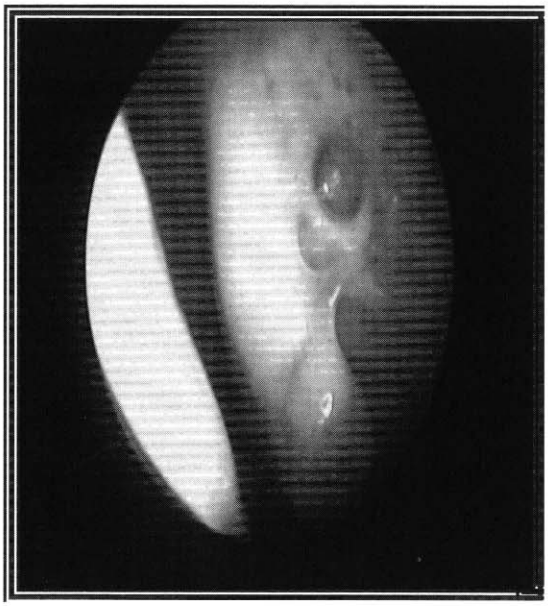

FIGURE 3 **Healed intranasal ostium after removal of the silicone tubes 6 months postoperatively.**

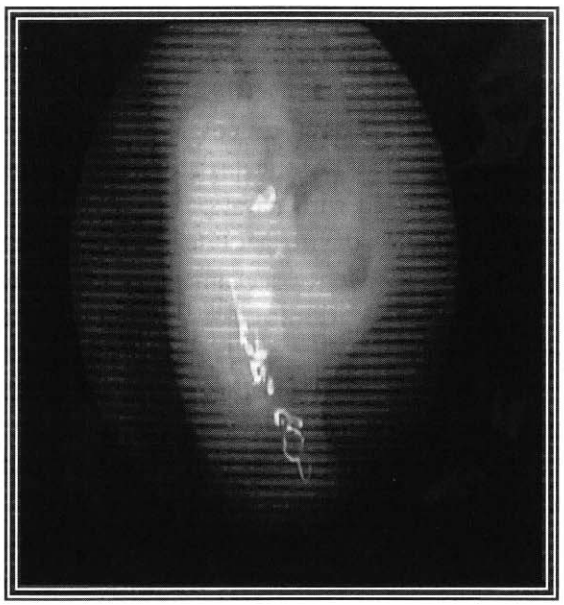

FIGURE 4 **Endoscopic photograph showing fluorescein dye flowing through the surgical ostium on lacrimal irrigation one year postoperatively.**

RESULTS

The study involved 112 patients treated for the relief of lacrimal obstruction. There were 102 patients with unilateral nasolacrimal duct obstruction (91%) and 10 patients with bilateral involvement (9%). One-hundred and twenty-two ERA-DCR's with double stent were performed in this study. Of the 122 procedures, 117 were primary ERA-DCR's and 5 were revision ERA-DCR's after a previously failed endonasal DCR. There were 27 (24.1%) men and 85 (75.9%) women ranging in age from 24 to 80 years (mean, 52.33 $\pm$ 15.75 years). Presenting symptoms were epiphora, recurrent conjunctivitis and chronic or recurrent dacryocystitis. All patients were followed-up for between 12 and 80 months (mean postoperative follow-up, 28.08 $\pm$ 14.71 months) for the evaluation of objective findings as well as subjective symptoms. There were no intraoperative complications. There were also no intraoperative or postoperative hemorrhages. Duration of the operation ranged from 35 to 40 minutes.

Septoplasty was done prior to ERA-DCR in 5 patients (5%). Functional endoscopic sinus surgery was performed at the time of the procedure in 12 patients (12%) due to concurrent nasal polyps. Middle turbinectomy, partial or complete, was avoided; instead, the middle turbinate was gently mobilized medially in 20 patients (20%), in whom the middle turbinates were obstructing access to the ostium site. The operation was defined as a success if: 1) preoperative epiphora resolved; 2) nasolacrimal patency was achieved as confirmed by either lacrimal irrigation or endocopic observation of fluorescein dye flowing from the eye into the nose through the surgical ostium after installation of 2% flourescein dye into the conjunctival sac. The resolution of epiphora was assessed by asking the patients about tearing after the removal of the Griffiths collar button and bicanalicular silicone tubes. By this definition, there were two failures.

Endoscopic radiofrequency-assisted DCR relieved nasolacrimal duct obstruction in 120 of 122 procedures for a surgical success rate of 98%. These two patients, both with unilateral nasolacrimal duct obstruction, had their follow-up visits only one and one-and-a-half month postoperatively. Thereafter, these patients were lost to follow-up and came back only after 3 and 4 months, respectively. At this time, postoperative endoscopic examinations demonstrated nasal mucosa migrating and covering the distal flanges of the Griffiths collar buttons (Fig. 5). Granulation tissue formation between the nasal mucosa and the edge of the distal flange of the Griffiths collar button was also encountered in three other patients but was not necessarily associated with the ostium occlusion that occurred 8–12 weeks postoperatively (Fig. 6).

DISCUSSION

Endoscopic lacrimal surgery has the primary advantage of avoiding an external scar and limiting injury to the nasolacrimal fistula. Because of these factors, recovery is generally more rapid, bleeding is minimized, and the patient is able to return to work or school earlier (Massaro et al., 1990).

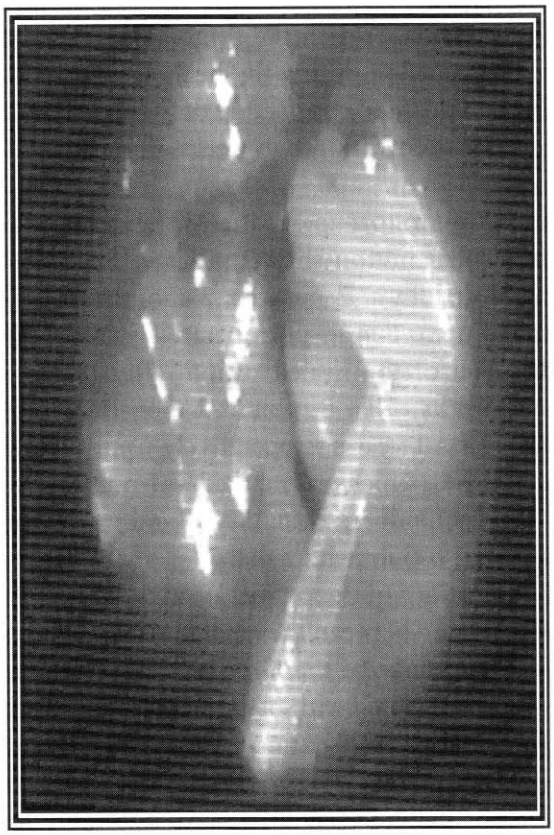

FIGURE 5 Endoscopic photograph showing nasal mucosa migrating and covering the distal flange of the Griffiths collar button.

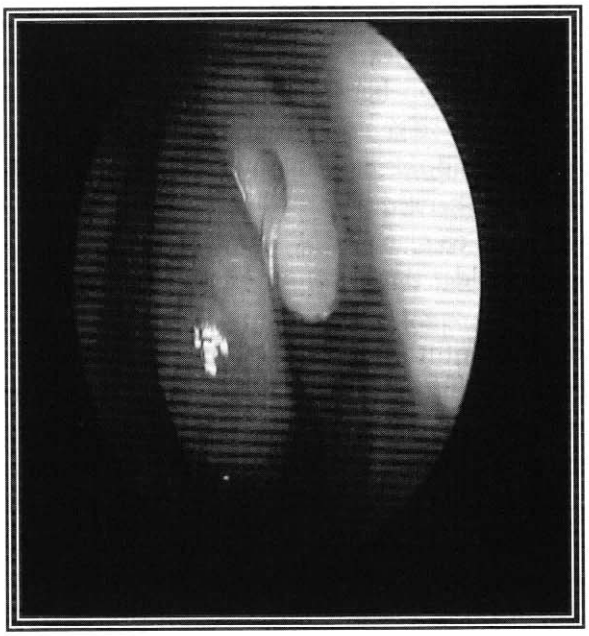

FIGURE 6 Endoscopic photograph showing granulation tissue formation between the nasal mucosa and the edge of the distal flange of the Griffiths collar button.

However, the main objections to endonasal DCR are doubts about the long-term patency because formal mucosal flaps are not created and the rhinostomy is smaller (Shun-Shin and Thurairajan, 1997). Unlike in external DCR, where suturing of nasal mucosa to lacrimal sac mucosa encourages healing by primary intention, the absence of formal mucosal flaps in endonasal DCR encourages greater postoperative fibrosis, where healing of tissues is largely by secondary intention (Ezra et al., 1998). This is probably one of the reasons for the higher failure rate in endonasal DCR. Transnasal endoscopic findings of fibrous tissue growth, scarring and granulation tissue formation have been noted at the osteotomy area during the healing process. The same healing process will also promote adhesion of the osteotomy to the turbinate and septum or induce obstruction of the common canaliculus (Liao et al., 2000). The use of a Griffiths collar button in this study definitely produced an improvement in the success rates compared with an earlier report on ERA-DCR (Javate et al., 1995). The insertion of a Griffiths collar button to straddle the osteotomy site not only prevents fibrous tissue growth, scarring and soft tissue obstruction at the rhinostomy site (Javate and Pamintuan, 1998), a proven cause of DCR failure, especially in procedures without sutured mucosal flaps, but also acts as a scaffold (Camara et al.,

2000) for the formation of an epithelium-lined passage for the egress of tears. It also prevents the development of adhesion between the ostium and the middle turbinate and the formation of synechiae between the ostium and the nasal septum (Woog et al., 2001). DCR failure caused by canalicular system closure has effectively been managed by maintaining canalicular intubation (Older, 1982) for an extended period of 3–6 months.

John D. Griffiths, MD, an oculoplastic surgeon from Nebraska (Griffiths, 1991), claims that a larger diameter stent through the nasal mucosa should logically create a larger nasal mucosa ostium. Sharing the same feeling, we started using the Griffiths collar button in all our cases of ERA-DCR since January 1997. The Griffiths collar button was first used in standard external-DCR in 1991 by Griffiths (Fig. 7) (Griffiths, 1991). The 1991 report by Griffiths failed to mention the success rate using the collar button in external DCR but confirmed the potential to increase the success of treatment. The Griffiths collar button is a nasolacrimal catheter designed for temporary retention in the lacrimal fossa and extending through the nasal mucosa for 5–6 months. The catheter is placed over the silicone intubation tubes to ensure the patency of the nasal ostium in SE-DCR (Griffiths, 1991) and endonasal laser DCR (Woog et al., 1993). This collar button catheter has a flange on both ends of the 5-mm shaft that virtually eliminates migration of the catheter either distally into the nasal cavity or retrograde into the lacrimal sac. The collar button design allows stabilization of the catheter with the collar button flange positioned so that the proximal flange overlies the nasal bony opening under the orbicularis muscle and the distal collar overlying the nasal mucosa. The catheter has a 5-mm interflange distance with a 3-mm lumen. The flat top configuration of the anterior and posterior flanges measures 12 mm in diameter by 0.5 mm in thickness, which allows flexibility during the placement and removal of this catheter. The Griffiths collar button is removed 2–3 months postoperatively. Removal of this catheter is accomplished very easily in the office. We elected to remove the Griffiths collar button 2–3 months postoperatively on the basis that the entire scarring process should have been completed by three months. Woog et al. (1993) reported that the average onset of ostium closure was 2–14 weeks (mean 7.5 weeks) postoperatively. A similar finding was also seen in the study of Kong et al. (1994). They reported that the average onset of ostium closure after the primary operation was 6–26 weeks (mean 12.7 weeks). A study on the ultrasonic assessment of rhinostomy size following external DCR, to assess the dimensions and patency of the surgical epithelial fistula, showed that from the first postoperative day, the soft tissue anastomosis was smaller than the rhinostomy and showed marked contraction during the healing phase and that over 90% of the total contracture of the soft tissue anastomosis occurred within two weeks after surgery (Ezra et al., 1998).

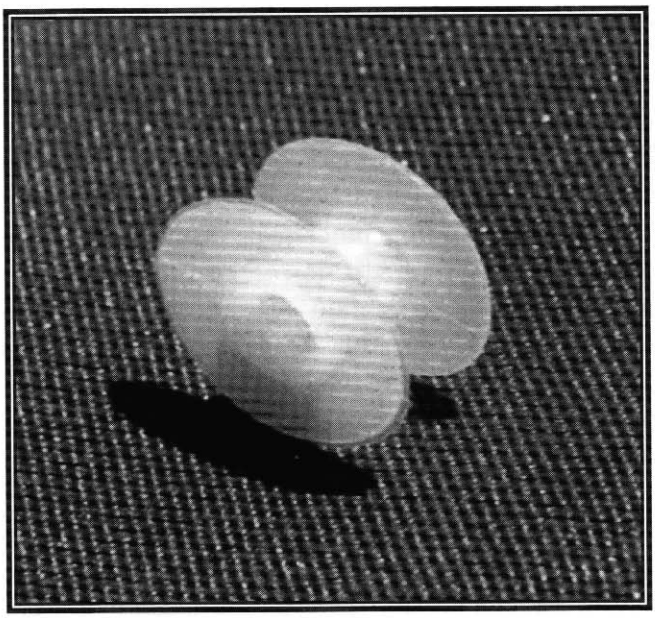

FIGURE 7 Griffiths collar button with proximal and distal flanges on both ends with a 3-mm lumen.

Endoscopic follow-up of patients after removal of the Griffiths collar button showed a large, finally healed, intranasal ostium at 2 months, 3 months, 6 months, 1 year and up to 6 years postoperatively. We measured the diameter of the healed ostium after the removal of the Griffiths collar button at 2 months, 3 months, 6 months and 1 year postoperatively using a Bowman probe No. 000, which was marked at 1-mm intervals as described by Lindberg et al. (1982) and which gave us an intranasal ostium with a diameter of 3 mm.

Complications of this procedure include granulation tissue formation between the nasal mucosa and the edge of the distal flange of the Griffiths collar button, not necessarily associated with ostium occlusion as seen in three patients, and migration of nasal mucosa covering the distal flange of the Griffiths collar button, as seen in two patients. These two patients were lost to follow-up after their initial visits at 1 and $1^1/_2$ months postoperatively and came back only 3 and 4 months

thereafter with the above findings. These two patients showed non-patency of the lacrimal drainage system when irrigated.

The postoperative care of patients who have undergone external DCR is simpler (Hartikainen et al., 1998; Javate and Syjuco, 1998), consisting of 3–4 follow-up visits, the removal of the skin sutures and the last visit to include the removal of the silicone tube. In contrast, endonasal DCR demands frequent postoperative follow-up visits for intranasal cleaning of debris and mucus at the rhinostomy site when clinically indicated (Hartikainen et al., 1998). In our patients, aside from endonasal debridement of the DCR ostium, mobilization of the edges of the distal flange of the Griffiths collar button was important to prevent migration of the nasal mucosa over the latter.

The adjunctive use of mitomycin C in endonasal DCR was suggested by Boush et al. (1994) to prevent closure of the rhinostomy site. Kao et al. (1997) published a series of seven patients who underwent external DCR with mitomycin C with a high success rate. Camara et al. (2000) likewise published his results with endonasal DCR plus mitomycin C and came up with a 99.2% success rate in his series of patients. Mitomycin was also used in the earlier report on ERA-DCR as an adjunct to endonasal DCR procedures to modify the healing process by inhibiting fibroblastic proliferation and scar formation and thus prevent closure of the rhinostomy. However, the 1995 study that used essentially the same surgical steps throughout the procedure except for the use of the Griffiths collar button yielded only a 90% success rate (Javate et al., 1995). Another study on the use of mitomycin C by Zilelioglu et al. (1998) revealed no benefit from the use of mitomycin C in endonasal DCR.

The importance of a large rhinostomy for the success of lacrimal surgery was also advocated by some surgeons on the basis that a small rhinostomy can end up with a small opening (Ezra et al., 1998), which is more likely to be associated with a "sump" syndrome as a result of poorly draining remnants of the lacrimal sac. There has been recent interest, however, in "inferior" or "terminal" endonasal DCR (Lun and Van Hasselt, 2000), in which a relatively small ostium is created at the junction of the lacrimal sac and NLD, thus avoiding development of a lacrimal sump syndrome. With the use of the Kerrison punch, an area of underlying lacrimal bone and frontal process of the maxilla, 8–10 mm in diameter, can be removed, creating a bony opening that suffices for the insertion of the proximal flange of the Griffiths collar button.

In summary, the increased success rate of ERA-DCR can be attributed to the following: additional modifications of the surgical technique, proper instrumentation, mastery of surgical details and careful postoperative follow-up. Endoscopic radiofrequency-assisted DCR with a Griffiths collar button shows a success rate of 98% in providing long-term patency of the intranasal ostium.

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