Original article

Corrective techniques of lacrimal obstruction in the vertical system

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ARTICLE INFO

Article history:
Received 21 July 2010
Accepted 1 October 2011
Available online 26 September 2012

Keywords:
Dacryocystorhinostomy
External dacryocystorhinostomy
Endonasal dacryocystorhinostomy
Transcanalicular dacryocystorhinostomy
Diode laser

ABSTRACT

Purpose: To describe current surgical techniques of dacryocystorhinostomy (DCR) and compare their effectiveness by analyzing the advantages and disadvantages between external, endonasal and transcanalicular surgery.

Patients and methods: A total of 91 DCRs were analyzed using a retrospective, cross-sectional and multicentre study in 75 patients who had symptoms of nasolacrimal duct obstruction. Of these, 28 were operated using external DCR, 31 endonasal technic, and 32 transcanalicular DCR with diode laser. Outcomes were evaluated subjectively using patient symptoms for the grade of epiphora and the results from the syringing before and after surgery.

Results: External DCR was performed in 28 cases, with 19 cases asymptomatic (67.85%), and 20 patients had a patent tract (71.42%). Endonasal DCR was performed in 31 cases, of which 19 cases were asymptomatic (61.29%), and 21 showed patency of the nasolacrimal duct (67.74%). A transcanalicular technique was performed in 32 cases, with absence of epiphora in 24 patients (75%), and the syringing was successful in 24 of them (75%).

Conclusions: Any of these 3 surgery techniques would be an adequate treatment for lacrimal obstruction, due to the significant development of endonasal and transcanalicular techniques in recent decades. With improvement, we could use either endonasal or trans-canalicular techniques with diode laser with the same level of effectiveness as the classic external approach, with the advantages of minimally invasive surgery.

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Técnicas correctoras de la obstrucción del sistema lagrimal en el sistema vertical

RESUMEN

Objetivo: Describir las técnicas quirúrgicas actuales de dacriocistorrinostomía, y comparar la efectividad de cada una de ellas analizando las ventajas y desventajas de la cirugía externa, la cirugía por vía endonasal y por vía transcanalicular.


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Dacriocistorrinostomía endonasal
Dacriocistorrinostomía transcanalicular
Láser diodo

Pacientes y métodos: Se realizó un estudio retrospectivo, transversal y multicéntrico en el que se practicaron un total de 91 DCR en 75 pacientes con clínica de obstrucción lagralmal, de las cuales 28 fueron realizadas con la técnica externa, 31 con la técnica endonasal, y 32 con la técnica transcanalicular con láser diodo. En todos los pacientes se valoró el grado de epifora subjetiva y la permeabilidad de la vía lagralma mediante la siringación previa y posterior a la cirugía.

Resultados: De las 28 DCR realizadas con la técnica externa, permanecieron asintomáticos 19 casos (67,85%), y la vía era permeable al alta en 20 (71,42%). Con la técnica endonasal de las 31 DCR practicadas fueron 19 los casos que permanecieron asintomáticos (61,29%) y 21 tenían la vía permeable al alta (67,74%). Y en la técnica transcanalicular el número de pacientes con ausencia de epifora al alta fue de 24 de las 32 intervenciones realizadas (75%), y la siringación fue permeable en 24 de ellos (75%).

Conclusiones: Cualquiera de las tres técnicas quirúrgicas puede emplearse como un ade-cuado tratamiento para la obstrucción de la vía lagralma, teniendo la técnica endonasal y la transcanalicular un importante desarrollo en las últimas décadas. Con su desarrollo y perfeccionamiento, se podrían igualar los resultados de la cirugía mínimamente invasiva frente a la técnica clásica, con las ventajas que esto supondría.

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Introduction

DCR is the indicated surgical procedure to resolve lachrymal and nasolachrymal duct (NLD) obstructions in adults. It consists of establishing direct communication between the lachrymal sac and the nasal fossa.1 The first modern DCR was performed by Toti in 1904 and modified in 1921 by Dupuy-Dutemps and Bourget.2 Between 1908 and 1910 West and Polyaic developed the endonasal pathway but the difficulties of endoscopic visualization of the nasal cavity and a steep learning curve caused the abandonment of this technique until the late Twentieth century.3 In recent decades a new approach has been developed, i.e., the transcanalicular approach, a simple and reproducible methodology which has become an option to be taken into account for treating lachrymal system obstructions.

In ophthalmological literature, the classic external technique is considered as the treatment of choice for resolving lachrymal pathway obstructions because it always obtained the best results and success rates.4 However, in recent years articles have appeared on endonasal and transcanalicular approaches with diode laser that shed new light about its efficiency. This would involve the possibility of utilizing minimally invasive surgical techniques, equaling the excellent results of external surgery.

This paper analyzes the three surgical techniques described above, measuring and comparing their effectiveness on the basis of anatomic and functional results, the appearance of clinic and the restoration of lachrymal pathway patency by means of siringing.

Subjects, material and method

A retrospective study with 75 patients between 29 and 83 years of age operated for DCR was carried out. The sample was collected from 3 surgery services of 3 different hospitals, each applying a different surgical technique, selecting 25 individuals from each hospital. Overall, 28 external DCR operations were performed by the Ophthalmology Service of the Valle del Nalón Hospital in Langreo; 31 DCR endonasal operations were carried out by the ENT Service of the Hospital de Cabueyes de Gijón, and 32 DCR transcanalicular interventions were performed by the el Ophthalmology Service of the Hospital San Agustín, in Avilés.

NLD obstruction was diagnosed by epihora clinic with or without mucopurulent secretion and by siringing, assessing the degree of patency of the lachrymal pathway. In 32 cases of transcanalicular DCR, dacryocystography was performed previously to assess the level of the obstruction.

During the follow-up period a second surgery was performed with the same technique in 6 out of the 28 cases intervened with the external technique, in 1 case out of 31 with the endonasal technique and in 5 cases out of 32 with the transcanalicular technique.

The external technique was performed under general anesthesia in some patients and local anesthesia with a mixture of 2% bupivacaine with 0.75% mevipacaine in the frontal internal cutout, at the level of the infraorbital nerve and around the lachrymal sac in others. After adequate anesthesia was achieved, a straight and vertical incision of about 12 mm was made at the level of the internal edge, with a subsequent dissection of tissue and removing the periosis of the lachrymal fossa in order to adequately release the sac. Subsequently an osteotomy of about 10–12 mm was performed in the lachrymal crest utilizing modified Citelli tweezers and Kerrison clamps. Then a rectangular section was made in the medial face of the lachrymal sac obtaining a flap with anterior base, making another similar flap with anterior base in the nasal mucosa and joining both. A bicanalicular intubation was made with silastic tubes (Xomed Treace) which were joined in the nasal fossa. After stitching the surgical wound, a nasal tampon impregnated with antisepctic (Furacin®) was placed and withdrawn the following day. Post-surgery care included lachrymal pathway cleansing with a mixture of corticoids and antibiotics, removal of the external suture one week after surgery, leaving the lachrymal pathway tutor for about 2 months.
In the operations performed with the endonasal technique, general anesthesia was utilized. A solution of lidocaine with epinephrine 2% (B Braun) with adrenaline 1/1000 was applied over the nasal mucosa to cause vasoconstriction. The nasal fossa was visualized with a 0° and 6 mm diameter endoscope (Estorz; Karl Storz, Buenos Aires, Argentina). A vertical incision of about 8 mm was made over the nasal mucosa in front of the lachrymosal duct relief, obtaining an inferior base flap. After removing the peristome of the bone, an 8–10 mm osteotomy was made with Kerrison clamps in order to make an incision in the posteroinferior lachrymal sac wall, creating an inferior base flap which was joined to the one obtained in the nasal mucosa. Finally, a bicanalicular intubation (Medtronic Ophthalmics; Medtronic Solar, Jacksonville, FL, USA) is made which was joined in the nasal fossa. Post-surgery care included the application of antibiotic eyedrops twice a day and nasal fossa cleaning with saline, and the withdrawal of possible granulomas and synechiae in the osteotomy area in successive checkups. Tutorization was withdrawn after 4–6 weeks.

The anesthesia applied during the endonasal intervention with diode laser was 2% lidocaine and epinephrine applied in the infraorbital nerve and in the lachrymal sac area. All patients were administered IV midazolam (Dormicum 7.5 mg; Roche, SA) at a dose of 0.05–0.1 mg/kg. After dilating the inferior lachrymal point, a 600 μm optic fiber was introduced to reach the medial wall of the lachrymal sac. Exeresis of the nasal mucosa was performed with diode laser (SurgiASE 30W) in continuous mode at a power of 10W and with the aid of a Kerrison hand tweezier. An osteotomy of 5–8 mm was made, applying mitomycin C in a dose of 0.4 mg/ml during 5 min in the nasal cavity. To end, a bicanalicular tube was placed (Medical Mix; Medical Mix Sl, Sant Cugat del Vallés, Barcelona, Spain) in all patients, and in 18 out of 32 cases a corticoid-impregnated cotton swab was left in the osteotomy area and withdrawn the following day. Post-surgery care consisted of the application of corticoid antibiotic eyedrops (Tobradex; Alcon) and intranasal corticoid (Rhinocort nasal; Astarazeneca, USA) 3 times a day and nasal fossa cleaning. In subsequent checkups possible granulomas and synechiae appearing in the osteotomy area were removed and tutorization was withdrawn after one month.

**Results**

The mean age of patients was of 64.05 years with a range of 29–83 years; 54 were females and 21 males; 27 right side,

| Table 1 – Epidemiological data of the cases included in the study. |
|-------------------|-------------------|-------------------|------------|
|                  | Mean age | Percentage of males | Percentage of females | Laterality |
|                  |    |                  |                      |           |
| External          | 63.04 | 28%               | 72%                  |           |
| Endonasal         | 64.6  | 20%               | 80%                  |           |
| Transcanalicular  | 64.52 | 36%               | 64%                  |           |

32 left side and in 16 patients both eyes were involved (Table 1).

Of 75 patients, 9 had undergone previous lachrymal pathway surgery (12%), 12 had a personal history of acute dacryocystitis, and 4 external DCR cases exhibited stenosis of the inferior lachrymal point.

An adequate result at the anatomic and functional level was considered to be a successful surgery. This was verified by means of epiphora clinic and lachrymal pathway exploration with syringing after surgery.

In the external technique, the percentage of patients without epiphora after surgery was of 67.85%, in endonasal surgery of 61.29%, and transcanalicular with diode laser of 75%. The percentage of lachrymal pathway patency after external technique surgery was of 71.42%, in endonasal surgery of 67.74%, and in transcanalicular surgery of 75%. The results were not statistically significant (Fig. 1).

In some patients a second intervention was made with the same technique: 6 with the external technique, 1 with the endonasal technique and 5 with the laser diode transcanalicular technique. The results after the second intervention were not statistically significant and did not involve changes in the success rate achieved for each technique.

Post-surgery events exhibited by patients were related to the presence of granulomas, synechiae or hematic remains in the osteotomy (4 patients) with inflammatory processes such as edema and fibrosis (4 patients), or exit of the guide (6 patients). All these complications were resolved conservatively.

The follow-up period was taken from the date of the first surgery up to hospital release. This period amounted to 8.55 months with a range of 6.61–10.48 months (in the external technique, 8.60 ± 7.48; in the endonasal technique, 4.28 ± 2.74; and in the transcanalicular technique, 12.76 ± 10.84).
Discussion

The three main surgical techniques available at present for treating DCR were compared. Similar results were obtained as regards effectiveness based on elimination of epiphora and restoration of the elevated lachrymal pathway patency, although with a lower success percentage than that published in other series.

However, in other studies the external technique continued to achieve the best results, with a success rate between 80% and 99% depending on the surgeon experience.5-7 In the results obtained by the various series, it is important to take into account the indications for each technique as high canaliculal obstruction diminishes the success rates of the external technique. Duffy and Hornblass found an overall percentage of 90% and when the canalicular disease was excluded the rate increased to 95%.5 In addition, surgeon experience and the surgical technique applied are important factors, as it is well-known that the utilization of mucous flaps in the external and endonasal techniques enhances anatomic improvement and pathway patency. In our series the double mucous flap was applied in our surgeries. However, Serin et al. did not find the differences in the results of the external techniques applying a double mucous flap instead of a single anterior flap, achieving a success percentage of 95.20%.

In the early days of endonasal surgery, comparative studies with the external technique evidenced better results with the classic technique. In 1997, Hartikainen et al. obtained a success rate of 91% with the external technique and 63% with the endonasal technique.10 However, it must be taken into account that the learning curve and surgeon experience with endonasal anatomy and acquired skills in the use of devices are crucial to analyze results.11 In recent years, the percentage of success of the endonasal technique has equaled the results of the external technique, as is the case in our study. Applying the endonasal technique, Tsirbas et al. obtained an overall success rate of 90% and observed that patients with functional alterations exhibited a lower success rate than patients with anatomical obstruction, with an 81% success of the former and 95% for the latter.12 Wormald was able to achieve a success rate of 95%13 at the anatomic and functional levels. The results of the application of laser-assisted endonasal technique seem to yield better results than the simple technique, although this is still under discussion as some authors do not agree. For instance, Maini et al. presented a study involving 66 patients where the percentage of success for laser-treated cases was 68% at 12 months and 74% in the simple surgery group.14

The transcanalicular technique is characterized by simplicity, short surgery time and low intra-op and postop morbidity, which is emerging strongly in the treatment of dacyrocystitis. The learning curve and the high cost of the material, as well as the need of being fully acquainted with nasal anatomy and the use of the endoscopic devices, are delaying the development of this technique.15,16 In its early days, poor results were obtained when compared with the classic external technique. In 1997, Patel presented a series of 24 patients intervened with the transcanalicular technique applying YAG laser and obtained a success percentage of only 46% in comparison with 85%17 achieved with the classic technique. It is important to utilize the right type of laser and to apply the technique with the adequate indication to obtain good results. We utilized the diode laser which has demonstrated high adaptability for this technique and performed previous dacyrocistography to avoid its use in case of high obstructions as this reduces its effectiveness, and opted for applying a different type of surgery in these patients.18 In our work, the patients with canaliculal obstruction intervened with diode laser only obtained 50% success. As proven by several studies, this technique is achieving very good results. Alánón et al. presented the preliminary results of a series of 34 patients with 11 months follow-up where the percentage of success reached 94.11%.19 In our study, the best results were obtained with this technique although these were very similar to the results of the endonasal and external techniques.

Doubtlessly, surgical techniques are in continuous development in the quest to perfect surgery and improve results. The insertion of tutors made of different materials such as silicone has reduced re-interventions due to early closure of the osteotomy, although some authors question its usefulness.20-27 The success percentages of surgical techniques are increasing due to the application of antimetabolites such as mitomycin C and 5-fluorouracyl.18-23 In our work, bicanalicular intubation was placed in all patients but mitomycin C was applied only in the transcanalicular interventions. As present, intranasal corticoids are being applied in the diode laser post-surgery in order to diminish inflammation and reduce synechiae in the osteotomy area. We found that 83% of patients who had a cotton swab impregnated with corticoids in the nasal fossa during the immediate postop experienced clinical improvements in comparison to the 69% of patients who were not administered corticoids.

In our study, several patients had to be intervened a second time with the same surgical technique, mainly patients who had been operated with the diode laser technique. The results of these re-interventions were not satisfactory and did not modify the success rates, with up to half of the cases exhibiting epiphora persistence and pathway obstruction. Even so, most authors were able to improve the success percentage of this surgical technique after performing re-interventions.14 The technique to be applied in second surgeries could be the same or an alternative technique could be performed. The transcanalicular technique can be performed on multiple occasions in the same patient because the anatomy of the pathway remains virtually intact. However, a switch to the external classic technique is usually practiced in case of surgical failure.

Osteotomy closure in the transcanalicular technique can be resolved with a second intervention, applying a combination of endonasal and endocanalicular techniques which, in contrast with transcanalicular technique on its own, minimizes thermal damage and avoids cicatricial reactions, with the enlargement of the osteotomy being less difficult due to the natural cavity provided by the nasal fossa.19

As of this time, no consensus has been achieved about the most adequate indications for each technique. The transcanalicular technique does not seem to be the best option in high obstructions. Several authors seem to agree in that the external technique, even though it does not yield clearly
satisfactory results, is the technique of choice in this type of obstruction. Pure endonasal technique, with or without laser and without endocanaliculal manipulation, is indicated in the acute phase to drain the abscess in the nasal fossa without diffusion to other tissues.\(^{21}\) The external technique is the only surgical possibility for patients with lachrymal pathway or nasal fossa tumors and require radical surgery. It has also proven useful in cases of dachryolithiasis and in patients with impervious lachrymal points where the endonasal technique also plays an important role. The transcanaclular and endonasal techniques do not produce antiesthetic scars, which must be taken into account in young patients.

Any of the 3 surgery techniques discussed above can be utilized as adequate treatment for lachrymal pathway obstructions, with the endonasal and transcanaclular techniques experiencing an important development in recent decades. When these techniques are perfected, they could equal the results of minimally invasive surgery against the classic technique, with the many advantages this would involve. Comparative studies between said 3 techniques are still necessary in order to establish the most appropriate indications for each.

**Conflict of interests**

No conflict of interests was declared by the authors.

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