

# Comparação do sucesso cirúrgico entre duas diferentes abordagens da via lacrimal, Dacriocistorrinostomia Externa e Transcanalicular, e entre duas diferentes faixas etárias.

## Comparison of surgical success between two different approaches of the lacrimal pathway, External and Transcanalicular Dacryocistorinostomy, and between two different age groups.

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### RESUMO

**Objetivos:** Comparar a taxa de sucesso cirúrgico da dacriocistorrinostomia (DCR) entre (1) duas diferentes técnicas: DCR externa vs DCR transcanalicular; e tendo em conta (2) duas faixas etárias diferentes: <65 anos vs ≥ 65 anos.

**Materiais e Métodos:** Trata-se de um estudo retrospectivo envolvendo 258 participantes submetidos a DCR entre 01-01-2014 e 31-12-2018. Definimos sucesso cirúrgico como uma resolução total dos sintomas iniciais analisados: lacrimejo excessivo, visão turva, inchaço doloroso do canto medial do olho, infeções recorrentes com secreção purulentas; ou uma resolução satisfatória: participantes que manifestaram uma melhora significativa, não consideraram os sintomas remanescentes significativos para exigir uma nova intervenção cirúrgica. Para responder aos objetivos propostos, foi aplicado o Pearson chi-square test para comparar o sucesso cirúrgico subjetivo entre DCR transcanalicular versus DCR Externa e entre duas diferentes faixas etárias: <65 anos versus ≥ 65 anos. Um valor de P igual ou inferior a 0,05 foi considerado estatisticamente significativo.

**Resultados:** Dos 258 pacientes incluídos no estudo, DCR externa foi realizada em 122 olhos, com sucesso cirúrgico relatado em 90,9% dos casos; 179 olhos realizaram DCR transcanalicular, com uma taxa de sucesso de 92,2%; não foi encontrada diferença estatisticamente significativa entre as duas técnicas ( $p=0,712$ ). No grupo com idade ≥ 65 anos, a taxa de sucesso variou entre 87,7%-89,6%, com diferença estatisticamente significativa ( $p=0,021$ ) em comparação com as taxas de sucesso superiores observadas no grupo mais jovem (93,3%-97,5%).  
**Conclusões:** Ambas as técnicas, DCR Externa e DCR transcanalicular, têm taxas de sucesso altas e comparáveis. Embora a taxa de sucesso na população acima de 65 anos seja estatisticamente menor do que a observada na população mais jovem, as taxas de sucesso cirúrgico permanecem altas e sem complicações adicionais.

**Palavras-chave:** Dacriocistite, Epífora, Dacriocistorrinostomia

### ABSTRACT

**Objective:** Compare the surgical success rate of dacryocystorhinostomy (DCR) between (1) two different techniques: External-DCR vs Transcanalicular-DCR; and comparing (2) two different age groups: <65 years vs ≥65 years. **Materials and methods:** Retrospective study involving 258 participants who underwent DCR between 01-01-2014 and 31-12-2018. We define as surgical success as a total resolution of the initial symptoms analyzed: excessive tearing, blurred vision, painful swelling of medial canthus, recurrent eye infection with pus discharge; or a satisfactory resolution: participants who manifest a significant improvement and that did not consider the remaining symptoms significant to require a new surgical intervention. To answer the proposed objectives, a Pearson chi-square test was applied to compare the subjective surgical success between Transcanalicular-DCR versus External-DCR and between the two different age groups: <65 years versus ≥ 65

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Artigo recebido a 8 de Abril de 2020. Aceite para publicação a 23 de Maio de 2020.

years. A *P* value of 0.05 or less were considered statistically significant.

**Results:** Of the 258 patients included in the study, External-DCR were performed on 122 eyes, with surgical success reported in 90.9% of cases; 179 eyes performed transcanalicular-DCR, with a success rate of 92.2%; no significant difference was observed between the two techniques ( $p=0.712$ ). In group aged  $\geq 65$  years, the success rate varied between 87.7%-89.6%, with a statistically significant difference, ( $p=0.021$ ) compared to the higher success rates observed in the younger group (between 93.3%-97.5%).

**Conclusions:** Both techniques, External-DCR and Transcanalicular-DCR, have high and comparable success rates. Although the success rate in the population over 65 is statistically lower than that seen in the younger population, surgical success rates remain high and without further complications.

**Keywords:** Dacryocystitis; Epyphora; Dacryocystorhinostomy

## INTRODUCTION

Acquired nasolacrimal duct obstruction (NLDO) is a fairly common disorder that occurs more frequently in females than in males<sup>1</sup>. The most common clinical manifestations of acquired NLDO are epiphora and acute or chronic dacryocystitis.

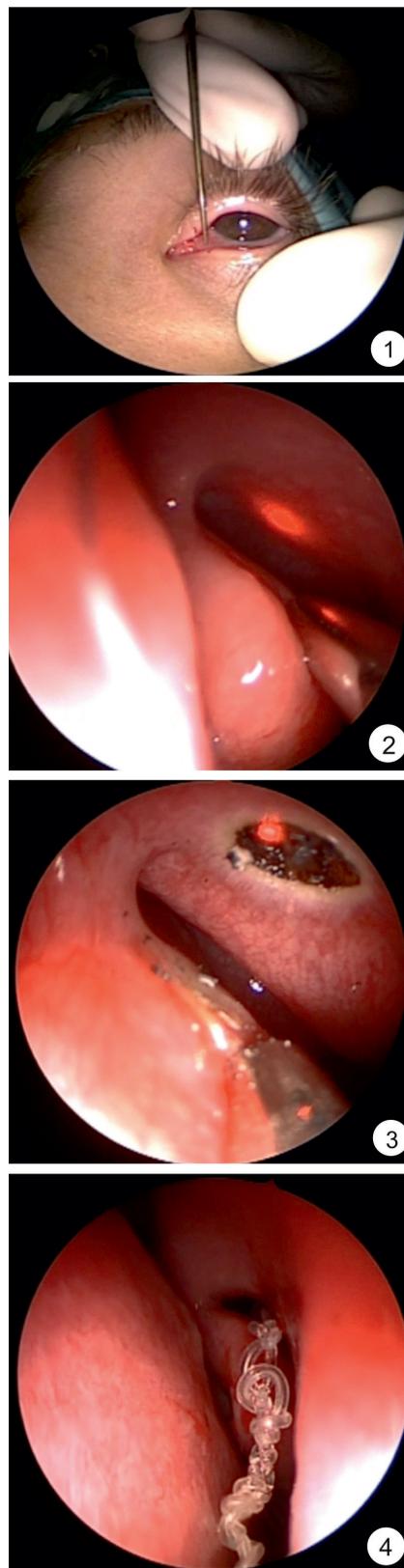
Dacryocystorhinostomy (DCR) has been established as the prevailing procedure for acquired NLDO<sup>2</sup>. External (EX-), Endoscopic (EN-), and Transcanalicular (TC-) DCR approaches based on the formation of a fistula between the nasal cavity and the lacrimal sac to ensure the continuity of the lacrimal drainage system can be used. Toti<sup>3</sup> first defined EX-DCR in 1904, and Dupuy-Dutemps and Bourguet<sup>4</sup> modified this procedure that has become the traditional and gold standard treatment of acquired nasolacrimal duct obstruction. Caldwell first described EN-DCR in 1893 and West and Halle later modified it<sup>5</sup>. These techniques were limited in use due mainly to the difficulty in visualizing the endonasal anatomy during the operation. The development of the operating microscope and rigid endonasal endoscope, made this technique popular again.

Improvements in lasers and laser devices allow surgeons to use minimally invasive techniques, including transcanalicular approaches<sup>6</sup>. The first transcanalicular laser dacryocystorhinostomy was performed with an argon laser<sup>7</sup>. Diode laser, holmium: yttrium-aluminum-garnet, potassium-titanyl-phosphate, CO<sub>2</sub> and neodymium: yttrium-aluminum-garnet laser were other types of laser used for TC-DCR<sup>8</sup>. Today, TC-DCR with a diode laser has been frequently utilized to treat primary NLDO<sup>9,10</sup>. In this procedure, a probe is inserted through the punctum via the canaliculus into the lacrimal sac following the anatomical pathway of tear outflow. Osteotomy is performed by laser energy through an optic fibre which is inserted within the probe. It has to be ensured that the aiming beam is at the brightest and is not scattered. Laser is fired only after confirmation in short pulses with equal gap intervals<sup>11</sup> - Figure 1.

In the literature, successful results have been reported using TC-DCR method<sup>12</sup>. Although the short-term results of TC-DCR have been reported in previous studies, the long-term results are still unclear. Moreover, although dacryocystorhinostomy is the definitive treatment for NLDO and has a high success rate reported in the literature (80% e100%) with a low complication rate (1%-6%), very few studies evaluate the specific outcomes for an elderly population<sup>13</sup>. Multiple factors confer an increased surgical risk on elderly patients, including functional decline,

## FIGURA 1

Transcanalicular Diode Laser-Assisted Dacryocystorhinostomy technique: (1) Probing lacrimal pathway; (2) Diode laser introduction; (3) Ablation/vaporization of the lacrimal sac/bone with diode laser with lacrimal sac exposure; and (4) Bicanicular probe placement.



reduced reserve capacity, polypharmacy, and comorbid medical conditions<sup>14,15</sup>.

The purpose of this study was to (1) compare the subjective surgical success rates reported by patients between TC-DCR (using a diode laser) and EX-DCR and (2) compare the surgical success between two different age groups: <65 years versus ≥ 65 years

## MATERIAL AND METHODS

We performed a retrospective study that included patients who underwent dacryocystorhinostomy (EX-DCR or TC-DCR) at the Centro Hospitalar Universitário do Porto, between January 2014 and December 2018. All patients aged ≥ 18 years; with unilateral or bilateral idiopathic lacrimal pathway obstruction at the level of the lacrimal sac or nasolacrimal duct, were included in the study. The evaluation was performed 6 to 8 months after surgery. Patients were excluded if they previously had undergone any surgery for tearing; were younger than 18 years at the time of surgery; if lack of complete clinical information in the process or loss of follow-up; if non-idiopathic NLDO, that is, cases where we identify a specific cause like exposure to radiotherapy, tumors, granulomatous diseases or NLDO after a history of facial trauma; and cases in which other anomalies were found in the nasal fossa requiring additional interventions, such as obstructive septal deviations, polyps and exuberant concha bullosa, since additional procedures could interfere with the surgical complications. All patients underwent an initial ophthalmological assessment and an EX-DCR versus TC-DCR was chosen according to the surgeon's experience and/or patient preference. All EX-DCR were performed exclusively by ophthalmologists and TC-DCR by a team of ophthalmologists and otorhinolaryngologists. The data were collected 6 to 8 months after the surgical intervention, in a follow-up consultation, and anatomic patency as confirmed by lacrimal irrigation. For all patients, the following data were collected: age, symptoms reported by patients (excessive tearing, blurred vision, recurrent eye inflammation with redness of the eye, recurrent eye infection with mucus or pus discharge, painful swelling near the inside corner of the eye), laterality (unilateral or bilateral), type of surgery (EX-DCR or TC-DCR), subjective outcome (classified as no improvement, satisfactory improvement or total resolution), need for review surgery (and surgical technique applied in surgical review) and major/minor surgical complications. The primary end point was surgical success, comparing the results obtained using the EX-DCR technique and TC-DCR technique. As we know, even with high-grade strictures confirmed by physical examination and imaging studies, the patient may have no significant epiphora complaints, or the opposite scenario can also be observed, where slight obstructions cause a very unpleasant epiphora for the patients. Therefore, in this study, despite the assessment of lacrimal pathway patency in an objective way in pre and postoperative consultations, we chose to emphasize the subjective outcome, in other words, patient satisfaction. We define as surgical success a "total resolution" or "satisfactory improvement" of complaints. When the resolution was not total, but the participants manifest a significant improvement and that they did not consider the remaining symptoms significant to require a new surgical intervention, we classify as "satisfactory improvement". If patients showed partial resolution, but still uncomfortable and with complaints, the result was not included in cases of surgical success, being

classified as "no improvement". Secondary end point included the surgical success rate of DCR between two different age groups: <65 years versus ≥ 65 years. Therefore, the rate of predefined major and minor complications also was evaluated; these included as minor complications: slight bleeding, stent displacement, synechiae in the middle meatus, emphysema in the medial canthus of the eye, skin scar infection, adherence of the tear points, canalculitis/conjunctivitis; and as major complications: death, vision loss, hemorrhage requiring intervention, and adverse event requiring hospitalization for any reason within 1 month after surgery. The surgical review was performed when there is no improvement or partial improvement, but not significant, remaining uncomfortable for the patient. In all of these cases, confirmation was made by lacrimal irrigation and whenever necessary an imaging study. Data collection was performed using Microsoft Excel 2019, and subsequently treated statistically using IBM SPSS Statistics version 25. Continuous variables were presented as mean ± standard deviation, while categorical data were represented as numbers and percentages. Categorical variables were compared between groups using the Pearson chi-square test, thus applied in the evaluation of the subjective surgical success between TC-DCR versus EX-DCR and to compare the surgical success between the two different age groups: <65 years versus ≥ 65 years. All differences associated with a chance probability of 0.05 or less were considered statistically significant.

## RESULTS

Between January 2014 and December 2019, and after applying the inclusion and exclusion criteria, 258 participants (301 eyes) were included in our study. The following data - demographic data, symptoms, and laterality of the pathology - are detailed in table 1. Most participants were ≥ 65 years old (155 participants) and 103 cases were under 65 years old. Overall, 78.7% were female (n = 203) and the remaining 21.3% (n = 55) were male, with a ratio of about 4 women affected by each man (4:1). This difference in relation to gender was greater when observed in particular the group with < 65 years old (7:1), and smaller in the group with ≥ 65 years old (3:1).

Some patients had more than one complaint prior to surgery, the three most frequent of which were: excessive tearing (88.8%); recurrent eye inflammation (22.1%); recurrent eye infection with pus discharge (9.7%). Thus, 301 eyes of 258 participants underwent surgery. The following data regarding the success rates between the two evaluated techniques are specified in the table 2. One hundred and twenty-two EX-DCR and 179 TC-DCR were performed. In the group of participants submitted to EX-DCR, a total resolution/satisfactory improvement of the symptoms was observed in 90.9% of the cases; the remaining cases that underwent TC-DCR, a total resolution/satisfactory improvement of complaints was reported in 92.2% of the cases. No statistically significant difference was found between the two techniques in terms of the success rate of surgery ( $p=0.712$ ). In the group of participants over 65 years of age, the success rate on EX-DCR was 89.5% and on the TC-DCR 87.7%, lower than those observed in the study population under 65 years (93.3% and 97.5%, respectively), and with a statistically significant difference ( $p=0.021$ ). In relation of surgical complications, regardless of the age group, no major complications were found in the intra and postoperative period. In relation to minor complications, these were observed in 15.6% of the cases (Figure 2). In 7 cases, intraoperative hemorrhage was observed

**TABLE 1**

Patient characteristics: age, gender, primary diagnosis and laterality

PATIENT CHARACTERISTICS			
<b>Age group (years)</b>		< 65	≥ 65
<b>Number of participants</b>		103	155
<b>Age (years) (median (range))</b>		45,9 (18-65)	74,5 (65-94)
<b>Gender, no. (%)</b>	Female	87 (84,5)	116 (74,8)
	Male	11 (15,5)	39 (25,2)
<b>Symptoms, no. (%)</b>	Excessive tearing	93 (90,3)	136 (87,7)
	Recurrent eye inflammation with red eye	12 (9,8)	45 (22,3)
	Recurrent eye infection with pus discharge	6 (11,7%)	19 (12,3%)
	Painful swelling in medial canthus	15 (14,6%)	37 (23,9)
	Blurred vision	6 (5,8)	23 (14,8)
<b>Laterality, no. (%)</b>	Right	41 (32,5)	67 (38,3)
	Left	47 (37,3)	68 (38,9)
	Bilateral	38 (30,2)	40 (22,8)

**TABLE 2**

Type of surgery and subjective outcome after surgery

TYPE OF SURGERY AND REPORTED SURGICAL SUCCESS	< 65 years	≥ 65 years
<b>External Dacryocystorhinostomy, no. (%)</b>	45 (35.7)	77 (44.0)
Total resolution	38 (84.4)	52 (67.5)
Satisfactory improvement	4 (8.9)	17 (22.0)
No improvement	3 (6.7)	8 (10.5)
<b>Transcanalicular Diode Laser-Assisted Dacryocystorhinostomy, no (%)</b>	81 (64.3)	98 (56.0)
Total resolution	69 (85.2)	53 (54.0)
Satisfactory improvement	10 (12.3)	33 (33.7)
No improvement	2 (2.5)	12 (12.3)

with easy control, being hemorrhage the only complication reported at the time of surgery. In the postoperative period, the three most frequent complications observed were: displacement of the stent (20 cases), canaliculitis/conjunctivitis in 7 cases, and synechiae in the middle meatus (5 cases). There was no difference in terms of complications when comparing the different age groups ( $p=0.777$ ). Surgical revision (table 3) was necessary in 61 eyes (20.3% of procedures): in 36 eyes, patients felt no improvement 3 months after surgery; in 25 eyes, patients felt only partial improvement, in patients with unilateral epiphora who opted for re-intervention. In 27 cases initially submitted to TC-DCR, surgical revision was performed with EX-DCR. However, in a very close number of cases, 29 cases, the TC-DCR was used as a method of surgical review of the external approach performed initially.

## DISCUSSION

In this study, we evaluated the surgical success of dacryocystorhinostomy reported by patients in different age groups and comparing two different surgical methods: EX-DCR and TC-DCR. Nasolacrimal duct obstruction is described in the literature as being a more frequent pathology in females in the

**TABLE 3**

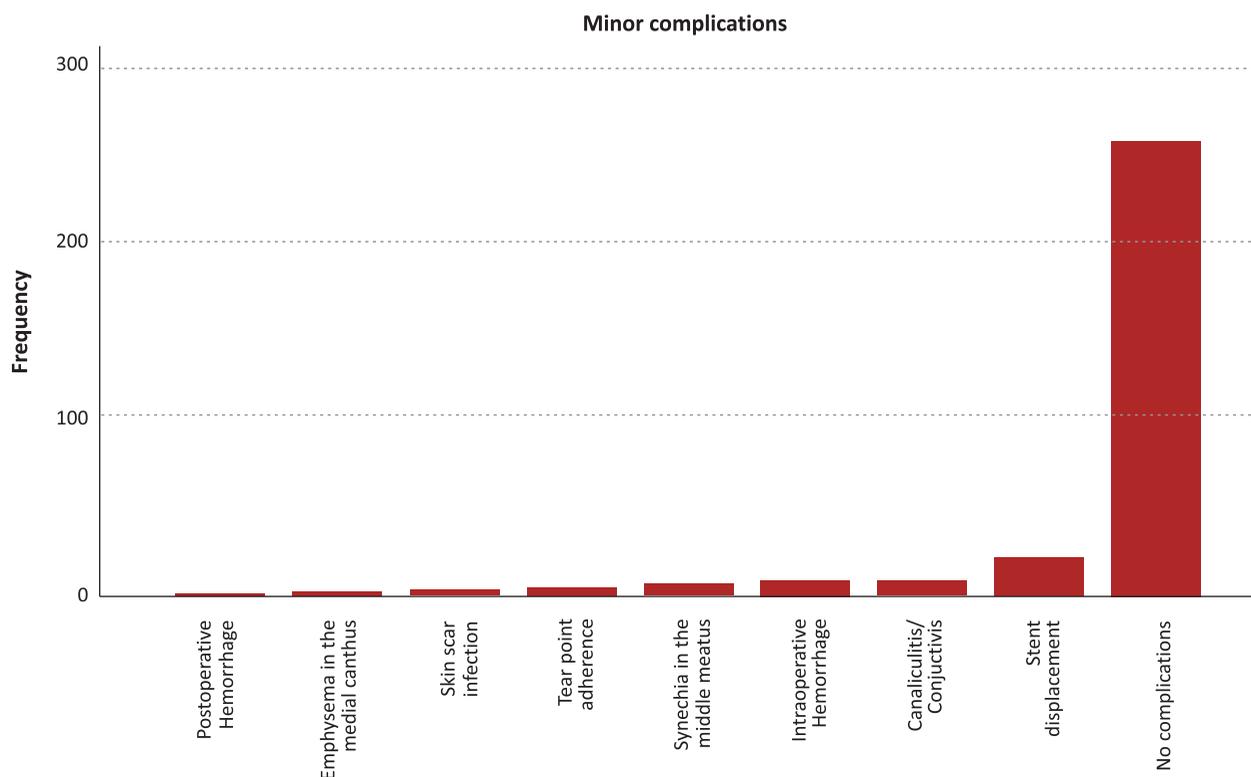
Cases submitted to surgical revision and type of Dacryocystorhinostomy performed. EX-DCR - external dacryocystorhinostomy; TC-DCR – transcanalicular dacryocystorhinostomy.

SURGICAL REVIEW		
Surgical review, no. (%)		61 eyes (20.3)
1st procedure	Review	
EX-DRC	TC-DCR	29
TC-DCR	EX-DCR	27
TC-DCR	TC-DCR	5
EX-DCR	EX-DCR	0

fifth or sixth decade of life<sup>16</sup>. Similar findings were observed in our study. Actually, comparing with a younger cohort, among elderly patients we observed a greater number of women with NLDO compared to men, similar to that observed in the younger group, however, the proportion among women and men seems to decrease with age. This can be justified by the

FIGURE 2

Bar graphic with surgical minor complications distribution



fact that inflammatory processes in the tear pathway, changes in the production of tears and changes in the pump mechanism are chronic inflammatory and degenerative processes that happen over the years, affecting both genders, reducing the difference found in the younger groups. EX-DCR is considered the gold standard treatment in the management of NLDO. The success rate in many recent series exceeds that obtained in previous reports, and in many cases it approaches the values of 90-95% achieved with the EX-DCR<sup>17,18</sup>. In the series by Onerci et al. in 2000, with 108 surgeries, a success rate of 94% was obtained, a value close to 92% of the series published in 2007 by Yigit et al., with 49 surgeries<sup>19,20</sup>. However, following the technical increase of the last decades in nasal endoscopic and laser/fiber optic surgery, TC-DCR has been the target of growing interest, which is reflected in the results obtained. Some studies have reported a higher success rate with EX-DCR compared to TC-DCR<sup>21,22</sup>. However, other studies have shown similar success rates. Nuhoglu F et al.<sup>23</sup> found out that there was 91.8% success rate in TC-DCR group and Suranagi MD et al.<sup>24</sup> found out in their study that success rate was 93.4% in EX-DCR and 92.2% in TC-DCR, that is, high and very close values. In our study, the success rate in the EX-DCR was 90.9% and in the TC-DCR was 92.2%, values that were close to the values reported in the literature, and no significant difference was found between techniques. Furthermore, there are few studies in the literature dedicated particularly to the older population, but success rates for DCRs in the order of 64% have been suggested<sup>13</sup>. In our study, the success rate for the population with  $\geq 65$  years varied in the interval, according to the different techniques, between 87.7% and 89.6% values (TC-DCR and EX-DCR, respectively) that are actually lower than those observed in the younger population, which varied between 93.3%-97.5% (EX-DCR and

TC-DCR, respectively), and this difference being significant. However, in the older population the values remain high, close to those observed in the younger population, and apparently without further complications. In fact, regarding complications, and in both surgical techniques evaluated, there were no major complications, even in the older group, suggesting that it is a safe surgical procedure. Minor complications were also similar in the two age groups assessed. However, the geriatric population is still an additional challenge when the goal is to treat lacrimal pathology:

- (1) they present multifactorial pathology of the lacrimal system, leading to other non-surgical causes of persistence of the epiphora: eyelid pathology; dry eye syndrome with reflex tearing - changes in the production of tears and functional changes in the tear pathway (pump mechanism);
- (2) Increased likelihood of tearing obstruction at multiple levels;
- (3) Higher probability of severe pathology: elderly patients with more uncomfortable symptoms may be willing to undergo surgery, while those with mild symptoms may be more likely to refuse surgical treatment.

EX-DCR has some disadvantages, such as cutaneous scarring, disruption of medial canthus anatomy, more difficult surgical review, duration of surgery and excessive intraoperative bleeding. But the EX-DCR also has some advantages, such as the direct observation of the lacrimal pathway (allowing the diagnosis of other pathologies such as tumors and granulomatous diseases, allowing the sending of material for pathological anatomy), it is a cheap procedure and the surgeons are familiar with.

In turn, TC-DCR, a more recent technique, has few studies in the literature regarding its long-term effectiveness. Furthermore, as in all endoscopic surgeries, the surgeon must have mastered

the classical approach first, to be able to use it in the case of intraoperative complications, and the laser must be handled carefully. The costs of this procedure are also higher when compared to classic surgery.

On the other hand, TC-DCR is a minimally invasive surgical procedure, having the advantage of accessing the operating field through anatomic pathways (the lacrimal canaliculus). This contributes greatly to minimizing trauma to the surrounding tissue and avoiding unnecessary surgical skin scars. It is also important to highlight the shorter surgery time<sup>25</sup> and lower blood loss. TC-DCR also plays an important role in surgical revision, namely surgical revisions of the EX-DCR technique. As it is a less invasive procedure, with less surgical time, and with success rates comparable to those observed in EX-DCR, it makes this surgical approach possible and safe in older patients with systemic problems. Even more, because it is performed by ophthalmologists and otolaryngologists together, it is possible to correct multiple obstructions at different levels of the lacrimal pathway and concomitant ophthalmological pathologies that contribute to the worsening of the epiphora, often present in the older population.

Summing up, the population over 65 years old is a special population, with a higher probability of multifactorial pathology of the lacrimal system, obstruction at multiple levels of the lacrimal pathway and more severe obstruction, as well as a greater number of comorbidities and polypharmacy.

However, epiphora can have a significant negative impact on quality of life and should not be neglected in this particular population.

Since success rates are high and with few major complications, DCR is an option after medical treatment fails. The TC-DCR presents success rates similar to those observed in the EX-DCR, with important advantages in the elderly population and, as such, it must be one of the main techniques to be considered in this population, associated with other procedures to approach the proximal lacrimal pathway when required.

The study we carried out has some limitations, starting with being a retrospective study and all the limitations that arise from it. It is important to note that: (1) only subjective functional improvement was evaluated, and the elderly population may be less demanding in the final result, and thus change the success rates reported; (2) results between 6 to 8 months after surgery may differ from more long-term results; (3) the distribution by the EX-DCR versus TC-DCR group was non-random, having been according to the surgeon's experience or the patient's preference, without well-defined criteria; (4) in some patients, other associated pathologies such as changes in the production of tears and changes in the pump mechanism, are more frequently present in the elderly population and these concomitant disorders can compromise the success rates; (5) no standardized questionnaire was applied for the subjective evaluation of surgical success.

## CONCLUSION

Studies showed that the success rates of DCR vary between 80% to 100%, similar to that observed in our study (91.7%), with no significant difference between the two techniques (EX-DCR versus TC-DCR). Regarding the two age groups evaluated, the success rate for the population with  $\geq 65$  years varied in the interval between 87.7% and 89.6%, according to the different techniques, that are actually lower than those observed in the younger population, which varied between 93.3%-97.5%, and

this difference was statistically significant. However, in the older population the values remain high, close to those observed in the younger population, and without further complications.

## Conflict of interests

The authors declare that they have no conflict of interest regarding this article.

## Data confidentiality

The authors declare that they followed the protocols of their work in publishing patient data.

## Protection of people and animals

The authors declare that the procedures followed are in accordance with the regulations established by the directors of the Commission for Clinical and Ethical Research and in accordance with the Helsinki Declaration of the World Medical Association.

## Privacy policy, informed consent and Ethics Committee Authorization

The authors declare authorization by Ethics Committee to carry out this study and they have written consent for the use of photographs of patients in this article.

## Financing

This work did not receive any contribution, funding or scholarship.

## Availability of scientific data

There are no publicly available data sets related to this work.

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