

# Conjunctivodacryocystorhinostomy With the Assistance of Diode Laser. Endoscopic Placement of Jones Lacrymal Tubes

Miguel Ángel Alañón Fernández, Félix J. Alañón Fernández, Asunción Martínez Fernández, and Manuela Cárdenas Lara  
Servicio de Otorrinolaringología, Instituto Internacional de Vías Nasolagrimales, Jaén, Spain

**Objective:** To describe and assess a surgical technique for cases of complete bicanalicular lachrymal destruction by means of the endoscopic insertion of the Jones tube with a diode laser to study functionality and complications.

**Patients and method:** A descriptive study of a case series with 24 consecutive patients with complete bicanalicular obstruction who underwent conjunctivodacryocystorhinostomy with diode laser. The surgery time, intra-operative and post-operative complications, long-term patency, and need for secondary revision were evaluated.

**Results:** Twenty-four consecutive patients were included in the study. All surgical procedures were successfully performed without significant complications. Average operating time was 15 minutes. The length of the tubes used ranged from 17 to 26 mm. Patients were evaluated at 24 hours, 3 weeks, 3 months, and 6 months, and then every 6 months. The most frequent post-surgical complication was the downward migration of the tube towards the nasal fossa (37.5%). Secondary intervention was performed in 6 patients. Success was demonstrated using the fluorescein test under endoscopic monitoring and represented 37.5% after the initial surgery and 50% including revision surgery.

**Conclusions:** Laser-guided endoscopic intubation is a speedy and accurate surgical procedure that is well-tolerated during the operation and leaves no scar on the skin surface. However, it is associated with a considerable number of post-surgical complications.

**Key words:** Canalicular obstruction. Conjunctivodacryocystorhinostomy. Endoscope. Diode laser. Jones tubes.

## Conjuntivodacriocistorrinostomía con láser diodo. Inserción endoscópica de tubos de Jones

**Objetivo:** Describir y evaluar la cirugía en los casos de destrucción canalicular total, mediante la inserción endoscópica con láser diodo del tubo de Jones para estudiar la funcionalidad y las complicaciones.

**Pacientes y método:** Se realiza un estudio descriptivo de una serie de casos consecutivos en 24 pacientes con obstrucción bicanalicular completa, a los que se practica una conjuntivodacriocistorrinostomía con láser diodo. Se valoró los tiempos quirúrgicos, las complicaciones operatorias y post-operatorias, la permeabilidad y la necesidad de reintervenciones.

**Resultados:** Se incluyó a 24 pacientes en el estudio. La cirugía se llevó a cabo en todos los pacientes sin complicaciones. El tiempo quirúrgico medio fue de 15 min. Los tamaños de los tubos usados fueron de 17-26 mm. Se efectuaron controles a las 24 h, a las 3 semanas y a los 3 y 6 meses, seguidos de revisiones cada 6 meses. La complicación posquirúrgica más frecuente fue el desplazamiento inferior del tubo hacia la fosa nasal (37,5%). Se precisó reintervención en 6 casos. Los éxitos demostrados mediante el test de tinción fluoresceínica con control endoscópico fueron un 37,5% tras una primera intervención y un 50% si se incluye una segunda reintervención.

**Conclusiones:** La intubación endoscópica guiada con láser es una cirugía precisa, rápida, bien tolerada intraoperatoriamente y sin cicatriz cutánea, si bien va asociada a un importante número de complicaciones posquirúrgicas.

**Palabras clave:** Obstrucción canalicular. Conjuntivodacriocistorrinostomía. Endoscopia. Láser de diodo. Tubos de Jones.

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Correspondence: Dr. M.A. Alañón Fernández.  
Pl. de los Jardinillos, 8, 1.º D. 23004 Jaén. España.  
E-mail: miguelaaf@msn.com

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## INTRODUCTION

The most frequent aetiology of complete canalicular obstruction is idiopathic. It is also seen following viral infections of the eye surface, trauma, Stevens-Johnson syndrome, traumas, and lachrymal surgery in patients who have previously undergone chemotherapy and radiotherapy. Those patients who have undergone a dacryocystectomy and are seeking a solution for an epiphora that affects their

**Figure 1.**  
Performance of  
osteotomy using  
laser fibre and  
insertion of the  
Jones tube.



day-to-day life are treated as having canalicular obstruction.

Complete bicanalicular obstruction has traditionally been treated with surgery as described by Lester Jones in 1965.<sup>1</sup> This procedure consists of a cutaneous incision, opening of the lachrymal sac by flaps, a large osteotomy, and placement of a tube between the conjunctiva and the nasal fossa. Although this technique is effective, it has drawbacks such as the fact that it is a difficult technique and the surgery requires a considerable amount of time. It is indicated when other surgical techniques are not feasible. If there is over 8 mm of open canaliculi, other alternatives<sup>2</sup> may be tried.

In 1982, Murube del Castillo<sup>3</sup> published the greatest modification of this technique, termed "conjunctivorhinostomy," which consists of placing a silicone tube through the soft tissue of the facial skeleton toward the nasal fossa without perforating the bone, thus connecting the lachrymal lake with the inferior meatus.

Thanks to optical systems, minimally invasive surgery has been developed for the lachrymal excretory system. Thus, over the last few years, we have gone from performing surgery requiring wide surgical fields to a situation where new technologies are used more and more instead of surgery.<sup>4</sup> Taking advantage of endonasal viewing by endoscopy and with the help of a diode laser (which shows us the location of the osteotomy by means of its guide light), we have performed a conjunctivodacryocystorhinostomy (CDCR) on our patients that directly links the conjunctiva with the nasal fossa, without having to make a skin incision, flap dissection, or having to perform a large osteotomy. Therefore, we should not confuse dacryocystorhinostomy, in which the larger osteotomies are beneficial, with conjunctivodacryocystorhinostomy, in which, theoretically, a small osteotomy would be better for stabilization of the permanent tube.

In this work, being as objective and honest as possible, on the basis of our own experience, with rather poor results (for the moment), we aim to encourage our colleagues to join us in reaching a more refined technique so as to provide a solution for those patients with this condition, where none has been available before now.

## PATIENTS AND METHOD

Between September, 2005, and November, 2006, a descriptive study was carried out on a consecutive series of

24 patients referred to the Tear Duct Institute in Jaén, Spain.

The patients included had symptomatic epiphora with a grade of  $\geq 2$  on the Munk scale and canalicular obstruction with less than 8 mm of open canaliculi, whatever its aetiology.

Those patients with bone fracture secondary to facial trauma, over 8 mm of open canaliculi or who had a epiphora grade of  $\leq 1$  on the Munk scale were excluded.

In every case anamnesis, an eye exam using a slit-lamp, tube placement, and irrigation to confirm the degree of obstruction were performed and the nasal fossa was studied by endoscopy.

All the patients gave their consent both orally and in writing.

The size of the Jones tube used was between 17 and 26 mm (Weiss Scientific Glass Blowing Company, Portland, Oregon, United States).

## Surgical Technique

Surgery was performed by the same surgeons (AFMA, AFFJ, and MFA).

Before the operation a nasal plug was placed using cotton gauze soaked in 1% tetracaine and 1/100 000 parts epinephrine (Braun topical anaesthetic with adrenalin; B. Braun, S.A., Barcelona, Spain) in the middle meatus, the inferior meatus and the nasal fossa 10 minutes prior to surgery in order to facilitate a good surgical field and good haemostasis before surgery. We discarded a prior infiltration of the mucosa to avoid the bleeding this infiltration causes.

Every patient was placed under conscious sedation with a continuous intravenous drip of remifentanyl (at 0.025-0.1  $\mu\text{g}/\text{kg}/\text{min}$ ) and midazolam (at 0.05-0.1 mg/kg).

A cannula was placed in the mouth for oxygen supply as the procedure was performed on the airway. Patients received a continuous flow of oxygen at 3L/min. The protocol also included the administration of intravenous metamizol or acetaminophen as painkillers.

The caruncula is infiltrated using a mix of 2% lidocaine (B. Braun Medical, S.A., Barcelona, Spain) and 0.5% bupivacaine with adrenalin (0.5% Svedocain with adrenalin; Inibsa Laboratories; Madrid, Spain). Using Westcott scissors, we cut away the lower third of the caruncle and place eye protection.

At the nasal fossa level, a 30°/4 mm endoscope is used together with a 600  $\mu\text{m}$  fibre from the 980 nm diode laser (Varius, Intermedic; Barcelona, Spain) to widen the opening.

The laser fibre is inserted in an inferomedial direction from the caruncula (where the conjunctival tissue incision was made) to the lachrymal bone (Figure 1). At that moment, and always under direct endoscopic control, the bone and nasal mucosa are vaporized by laser shots with an average power of 10 W (6-12 W) until it can be seen in the middle meatus, behind the ascending maxillary branch, and in front of the head of the middle concha. The average power used was 292 J (110-520 J). The same laser fibre can be marked from its entry into the conjunctiva until it exits through the nasal mucosa; its length coincides with the size of the Jones tube used.

The tube slides down the laser fibre until it enters the osteotomy and reaches the nasal fossa lumen and should

come out about 3 mm above the nasal mucosa (Figure 2) to prevent its re-epithelization and subsequent obstruction of the tube. In conclusion, it is fixed to the lower eyelid with a non-absorbable 6-0 prolene suture, which is kept in for 3 weeks (Figure 3).

All of the surgeries were performed as out-patient surgeries. The average duration of the surgery was 15 minutes (12-22 minutes).

Neither a nasal plug nor eye compresses were needed.

We record surgery times, complications between surgeries, tube size, and confirmation of the patency of the new fossa by means of endoscopic monitoring and fluorescein instillation, which we refer to as the endoscopic staining test (Figure 4).

An antibiotic-steroid eyewash is prescribed 4 times a day for 2 weeks in the inferior conjunctival cul-de-sac and some antibiotic-steroid, and vessel constriction drops 3 times a day for 5 days in the nose, followed by saline solution rinses every 12 hours for 1 month.

Follow-up evaluations were performed the day after surgery, then at 3 weeks, 3 months, 6 months, and then every 6 months.

All patients are given an eye exam with a slit-lamp, distilled-water irrigation to clean the tube, patency verification by means of the endoscopic staining test, examination of the nasal fossa, and cleaning if there are secretions and scabbing of the ipsilateral nasal fossa. We also record whether or not there is residual epiphora, quantified according to Munk's scale, post-surgical complications, and whether or not a second intervention was needed.

Surgical success was defined as a grade 0 epiphora on Munk's scale and confirmation of tube patency by irrigation, and the endoscopic staining test.

## RESULTS

The surgery was performed and completed on 100% of the patients. There were no complications during surgery; 6 patients were female and 18 were male; mean age was 55 (34-70).

The aetiology was idiopathic in 9 cases, infectious in 9, post-surgical in 4, and secondary to trauma with bone fractures in 2.

The percentage of patients who presented total patency following initial surgery was 37.5%, with follow-up periods between 6 and 20 months. Final patency after revision surgery for those cases that were unsuccessful following the initial surgery increased to 50%.

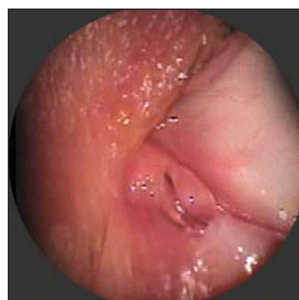
Table lists some of the complications most frequently seen, according to the moment they first appeared.

Incidence of Most Frequent Complications, %

	<i>Migration of the Lower Tube</i>	<i>Upper Extrusion</i>	<i>Pyogenic Granuloma</i>	<i>Acute Dacryocystitis</i>
3 weeks	4.17	0	0	0
3 months	25	4.17	4.17	4.17
6 months	8.3	8.3	0	0



**Figure 2.** Position of the tube at the level of the nasal fossa.



**Figure 3.** Position of the tube at the level of the caruncula.



**Figure 4.** Verification of the tube's patency using fluorescein.

Other complications described were: sensation of a foreign body (4.17%) and mucous secretion (4.17%).

## DISCUSSION

CDCR by inserting tubes is the treatment of choice for complete bicanalicular obstruction when there is at least 8 mm of open canaliculi. The procedure consists of draining tears from the lachrymal lake to the nasal fossa through a new drainage pathway.

The main mechanism for operation of the tube is by capillarity from the palpebral opening to the nasal cavity, added to the gravity from the way the tube is placed, and



suction from the negative nasal pressure occurring during inhalation, which sucks in the tears through 2 drainage tubes.

Traditionally, this technique was performed under general anaesthesia by making an external cutaneous incision, which is a procedure similar to an external DCR.<sup>5</sup> The drawbacks of this are bleeding, prolonged surgery, post-surgical morbidity, and cutaneous scarring.

There are several frequent CDCR complications due to shifting or intolerance of the tubes. Several materials,<sup>6-9</sup> shapes,<sup>10,11</sup> grafts,<sup>12</sup> and flaps<sup>13</sup> have been described to avoid these complications.

The use of a holmium laser has been linked with a high success rate and a low morbidity rate.<sup>14,15</sup>

The search for a speedy technique that is well-tolerated by the patient, with short surgery times, no cutaneous scarring, and minimal bleeding have led us to use a diode laser. Even though laser use increases the initial cost of the process it also avoids expenses from having to admit patients to the hospital, using general anaesthesia, and higher needs for control. It also improves operating-room performance.

We have conducted a study of 24 patients. The literature contains series with 7 or 9 patients up to others with as many as 105 patients.<sup>16,17</sup>

The minimum follow-up period was 6 months. We decided on this short timeframe because it is during the 3 months following surgery when complications occur most frequently. The work of Rosen et al<sup>18</sup> and Sekhar et al<sup>19</sup> coincide with this observation.

CDCR using a diode laser minimizes the tissue damage in comparison with other techniques that perform direct communication with the nasal fossa through Bowman,<sup>20</sup> Abbocath,<sup>16</sup> or trephine catheters.<sup>17</sup> The laser guide-light helps us to orient the laser fibre and mark the ideal location for penetration, checking transillumination with direct visualization using the endoscope. Using other methods would mean going in blind from the conjunctiva entry until the exit to the nasal fossa. This way the serious risk of a posterior shift toward the orbit (an accident which would have horrendous consequences) is avoided.

The laser, thanks to its good ability to vaporize, penetrates the lachrymal bone where it is thinnest and thus presents the least resistance (ie, the area with the highest degree of transillumination), something that we do not always achieve when we try this with a 14 G Abbocath.

The power we use is 8-12 W. Using over 12 W burns the tissue, which then leads to a loss of the transillumination and thus the orientation of the osteotomy point.

The osteotomies effected by laser are 5 mm in diameter; since the tube is 4 mm, it seems ideal for a good fit, compared with external CDCR osteotomy, which is usually 10-12 mm. Several authors have stated that a small osteotomy may lead to better results since the tube fits more tightly.<sup>14-16</sup> In spite of this theoretical advantage, our study has shown that the incidence of displacement is still high.

In the case of narrow fossae we dislocate the middle concha medially toward the nasal fossa lumen and the lower concha sideways, placing it on the side wall of the nasal fossa and trying to expand the surgical field and the nasal fossa lumen. We should try not to damage the mucosa of the nasal

fossa or the conchae, since the incidence of synechiae following the surgery would increase, and we make sure that the tube does not come in contact with the head of the middle concha nor the nasal septum so as to avoid obstruction.

When we introduce the Jones tube using the classic external path, at an angle of less than 10°, it comes out in the nasal fossa at the middle concha insertion. This area corresponds externally to the insertion of the medial canthal tendon. In this way the tube is placed at a more horizontal level than with our technique, which means that it does not favour tear drainage as much.

By using the laser fibre, it can be directed in an inferomedial fashion to facilitate tear drainage due to gravity and the negative pressure created during inhalation corresponding to breathing through the nose.

In our series no patient presented epiphora in decubitus position while the tube remained permeable.

The average time needed for this technique is fifteen minutes, which is clearly advantageous in comparison with external CDCR (74 minutes) or endonasal CDCR (59 minutes).<sup>21,22</sup>

Acute dacryocystitis processes have been described in patients with Jones tubes in place. There was 1 case in our series, which was a patient with a mucocele and a completely obstructed lachrymal canal. In that case, we might have avoided this process with a more generous external CDCR, eliminating the accumulation of purulent material around the tube. Schellini et al<sup>23</sup> attribute their case to an underlying ethmoiditis. From this, we conclude that it is necessary to take into account, and resolve before performing the technique, any sinonasal condition that may later lead to an acute process and thus failure of the surgical intervention.

In our series, the most common complication was the downward shifting of the tube toward the nasal fossa, which is impacted within the lumen of that fossa, thus behaving as a foreign object. We attribute this to the longer lengths and heavier weights of the tube used in this technique in directing the laser fibre lower than if used externally. Another explanation that we have considered is that the surrounding tissue retraction following the oedema and inflammation resulting after the surgery, as well as osteogenesis, may also contribute to the shifting of the tube.

For cases in which displacement occurs, Devoto et al<sup>16</sup> propose the solution of choosing a wider tube neck diameter (4.5 mm).

The need to replace these tubes has been seen in 36%-82% of cases.<sup>18,19,21</sup> These tubes require long-term care and cleaning by an ophthalmologist and ENT practitioner.

Minor complications, such as granulomas<sup>24</sup> and the frequent need to clean out the secretions, are often seen following a CDCR. Kaynak has solved the issue of the granulomas by switching the Pyrex tube material to PVP coated silicone. The ideal tube would be made up from consistent hydrofuge material with low tissue reaction.

All patients were informed, verbally and in writing, of the need to come back to our clinic if a sudden increase in tear production was noticed. In these cases, the tubes were replaced using topical anaesthesia in our clinic if it appeared

soon afterwards (in less than 5 days). If the symptoms persist over a long period of time, complete occlusion of the tube by the conjunctiva or the mucosa is likely, therefore replacement through surgery is required.

The success rates of these are varied and go from 37% to over 90%.<sup>18,19,25</sup> Consequently, it would be desirable to define and use objective success criteria since those found in different studies are not homogeneous. For example, Lim et al<sup>25</sup> state a 94% success rate defined as "absence of comfortable epiphora" with no frequent complications; however, they admit that only 70% of patients were satisfied with the results. It would be desirable to include Munk's test and confirm tube patency by irrigation and the endoscopic staining test in all patients. One of the causes of our lower success rate may be the strict objective criteria used.

To conclude: CDCR using laser is a quick procedure with direct monitoring and allowing the performance of minimally invasive surgery entailing few surgical complications and a low morbidity rate immediately after surgery. However, keeping these permanently tubes in place carries a high risk of post-surgical complications, regardless of whether an endonasal, laser, or external technique is used.

This is why we consider the diode laser to a helpful surgical instrument. We should not consider this to be the panacea, but at the same time it must not be thought of as the cause of all the failures. Just as it would not be logical to attribute the complications and failures of external CDCR to the use of a cold scalpel. Similar complication percentages have been described by Rosen et al<sup>18</sup> and Sekhar et al<sup>19</sup> and they did not use the diode laser.

It would be good to continue studying and developing new materials to reduce complications and increase tolerance in this passionate field of research.

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