Endolacrimal KTP Laser–Assisted Dacryocystorhinostomy

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Objective: To describe our experience with potassium-titanyl-phosphate (KTP) laser–assisted dacryocystorhinostomy, controlled via endolacrimal and endonasal endoscopy. The development of miniendoscopes enables endoscopy of the lacrimal drainage system via the lacrimal puncta to visualize the exact site of a stenosis.

Design: A case series of 78 patients, with 1-year postoperative follow-up.

Settings: A university medical center.

Patients: Consecutive sample of 78 adult patients who required surgery for dacryostenosis.

Intervention: Endolacrimal use of a KTP laser to perform a bony osteotomy of the lacrimal sac into the nasal cavity. The position for the perforation was controlled by endonasal endoscopy. The procedure was performed under either general or local anesthesia.

Results: One year after surgery, 65 (83%) of the 78 patients were free of symptoms. Seven patients experienced intermittent tearing, and 6 had revision surgery because of restenosis.

Conclusions: The success rate of 83% achieved with KTP laser–assisted dacryocystorhinostomy, using miniendoscopes for lacrimal endoscopy to visualize the exact site of obstruction, is better compared with that of prior studies without the use of miniendoscopes (with success rates of 47%-85%). The advantages of this technique are that it is a minimally invasive procedure, requires a short operating time, and avoids use of an external incision.


S Tenosis of the lacrimal canaliculi or nasolacrimal duct may cause recurrent tearing, blurred vision, or epiphora. Thick mucus is often expressible from the lacrimal sac. Acute dacryocystitis is characterized by painful swelling and erythema of the medial canthal area. Repeated irrigation of the lacrimal system can reopen the stenosis and resume normal drainage. If unsuccessful, surgical treatment is required. External dacryocystorhinostomy (DCR) is the most common and well-known surgical method to restore the nasolacrimal system. During recent years endonasal DCR was developed as an alternative surgical technique. Endonasal DCR can be performed with the help of rigid endoscopes or under binocular operating microscopes. The advantage of the endonasal approach is the short procedure time and the exemption of an external skin incision. This article presents a further development of DCR using an endolacrimal potassium-titanyl-phosphate (KTP) laser and a miniendoscope for endoscopy of the lacrimal drainage system. The endoscope is thin enough to pass the lacrimal puncta and canaliculi. This technique enables visualization and precise location of lacrimal disease, such as mucosal deposits, inflammatory membranes, strictures, or scar tissue (Figure 1). In addition, it is now possible to insert very thin KTP laser fibers through a working channel of the miniendoscope to perform the bony osteotomy (Figure 2). The exact position of the bony osteotomy is controlled via nasal endoscopy with rigid endoscopes (Figure 3 and Figure 4). This device guarantees good visualization during the laser surgery. We report a series of 78 patients treated with this new method.

METHODS

PATIENTS AND PROCEDURES

We performed KTP laser–assisted DCR on 78 consecutive patients with dacryostenosis. The initial diagnosis of obstruction of the lacrimal sac or nasolacrimal duct was verified via endolacrimal endoscopy using miniendoscopes. Expen-
sive and time-consuming procedures such as scintigraphy or digital subtraction scintigraphy were not performed. Twenty-six patients were operated on under general anesthesia and 52 under local anesthesia. After irrigating and cleansing the lacrimal drainage system, the lacrimal probe with the laser fiber tip and the endoscope were positioned next to the medial wall of the lacrimal sac. After dilating the lacrimal puncta with a probe, the lacrimal system was cannulated with the miniendoscope. The precise location of the stenosis was then verified via lacrimal endoscopy. The red guiding light of the laser tip was visualized via endonasal endoscopy. With this technique the exact position for the osteotomy in the agger nasi area anteriorly to the middle turbinate could be verified. A bony osteotomy of at least 5 mm was achieved with 6 to 10 W of energy. The total amount of energy required was 124 to 432 J (mean, 256 J). The time of surgery ranged from 3 to 6 minutes (mean, 5 minutes). Bicanalicular silicone intubation was performed and tubes left in place for a period of 3 to 6 months (Figure 5). In all patients a bony osteotomy was achieved via KTP laser. No complications, such as bleeding or infections, were observed. This study presents 1-year postoperative follow-up results. Follow-up controls were done 3, 6, and 12 months after removal of the silicone tube.

TECHNICAL EQUIPMENT

A modified lacrimal miniendoscope (Waveguide Laser Systems GmbH, Vienna, Austria) was used. Light fibers are arranged in a metal cannula with an outer diameter of 1.1 mm and an inner diameter of 0.9 mm. The entire unit consists of a xenon light source (Lisa Basic xenon light source; Medexxa Medical Equipment GmbH, Hasloh, Germany), a video camera (Sony, Tokyo, Japan) with an ocular attachment, and a miniature CCD camera system with monitor (Sony HR Trinitron) and video recorder (model SVO 9500 MDP; Sony). The KTP laser (Waveguide Laser Systems GmbH) consists of a 0.3-mm flexible laser fiber surrounded by a synthetic coat. The KTP laser emits green light at a wavelength of 532 nm with a Q-switched mode in single or continuous pulses. The laser cuts in contact mode and coagulates in near contact mode with a maximum of 10 W. We used a modified lacrimal probe with 3 ports. The laser is inserted via the central port, the miniendoscope and irrigation fluid via 2 side ports (Figure 2). For endonasal endoscopy a rigid Storz 0° or 30° endoscope with eye filter for laser protection (Storz Halogen 250 Twin; K. Storz, Tuttlingen, Germany) was used.

RESULTS

In all patients, the preoperative diagnostic lacrimal endoscopy showed soft tissue scarring of the lacrimal system due to chronic recurrent inflammation. No bony stenosis secondary to trauma or surgery was found. Postoperative nasal endoscopy showed bony osteotomies measuring $3 \times 3$ to $5 \times 5$ mm in diameter. Sixty-five (83%) of the 78 patients were free of symptoms 1 year after surgery. Seven patients experienced intermittent tearing in extremely cold weather. Six patients had restenosis with tearing and massive secretion. In cases of restenosis we found membranous tissue in the area of the osteotomy. Restenosis occurred 3 to 6 months postoperatively. All 6 cases of revision DCR were performed endonasally to create an optimal wide bony osteotomy. The ophthalmologist inserted a lacrimal stent, which was left for 3 months. We chose the endonasal approach for revision due to our good experience in endonasal endoscopic surgery and to avoid an external skin incision.

COMMENT

This article presents a technique using a KTP laser fiber threaded through the canaliculi with simultaneous lacrimal endoscopic visualization. With the miniendoscope it is possible to identify the precise location of the stenosis and to use the KTP laser at the same time.
advantages of the technique are the minimal invasive character and the short procedure time. During recent years different lasers have been used for canaliculoplasty and/or DCR with variable success rates. In his report of the possible use of lasers for lacrimal surgery, Bartley described different kinds of lasers to perform DCR. In his opinion, the higher costs and lower success rates of a new technique must always be compared with the 90% success rate of the conventional external DCR.

In initial attempts with transcanalicular DCR, Christenbury and Massaro and colleagues used an argon blue laser with up to 70% success rate. Christenbury reported difficulties in achieving the bony osteotomy with 3.2 W of energy, while Massaro et al found the tissue to be traumatized with an energy of 16 W.

Dutton and Holck used a holmium laser for opening complete or incomplete canalicular stenosis, and found that 57% of their patients showed at least moderate improvement as regards epiphora and canalicular patency. In their opinion, the 57% success rate justifies this minimal invasive approach especially in comparison with alternatives such as Jones tube surgery or canaliculo-dacryocysto-rhinostomy. Patel et al reported the use of a Nd:YAG laser for revisions after transcutaneous DCR with only a 46% success rate, which is a poor result compared with the 90% success rate with external DCR. Their intracanalicular revision laser DCR took 25 minutes longer than the conventional external DCR. They concluded that laser-assisted DCR is not a reasonable technique. Dutton and Holck and Patel et al performed transcanalicular laser surgery without direct endoscopic visualization of the lacrimal drainage system and its mucosa. However, Pearlman et al achieved a success rate of 85% with a transcanalicular Nd:YAG laser under intranasal endoscopic control in a series of 42 patients with a mean follow-up of 12.6 months. Their group reported no problems in performing the laser osteotomy nor intraoperative or postoperative complications. Caversaccio et al performed a transcanalicular DCR with erbium:YAG laser on 12 patients, which is a technique characterized by excellent cutting properties in soft and hard tissue. Due to the strong absorption in water, the deposited energy remains in a restricted volume, which increases the precision of this laser. One disadvantage is the limited possibility to coagulate.

Levin and Stormogipson used a KTP laser in cadavers to create a 6 × 6-mm bony window. This technique is supported by Gonnering and colleagues, who successfully performed endonasal DCR with a KTP laser in 12 patients. They were able to create a bony window of 5 × 6 mm with an energy of between 5 and 7 W.

In our opinion, the use of a lacrimal endoscope helps to locate the site of the stenosis and to select the appropriate surgical procedure intraoperatively. Lacrimal endoscopes allow direct visualization of the canaliculi, lacrimal sac, nasolacrimal duct, and their mucous membranes. In 1992, Fein et al reported endoscopy of the lacrimal outflow system in a small number of patients. Singh et al described endoscopic visualization of the nasolacrimal system in 4 cadavers. They believed...
that the endoscopes were too flexible to be inserted into the upper canaliculus and the nasolacrimal duct. Kuchar et al\textsuperscript{13} described their experience with specially designed and modified endoscopes; however, the picture quality was not satisfactory. The endoscopes we describe are thin and flexible and are used with a modified Janemann probe. Newer lacrimal endoscopes with better physical and optical properties can now produce excellent lacrimal images (Waveguide Laser Systems GmbH). With miniaturization of integrated endoscopes (outer diameter, 0.3 mm or 0.7 mm) and a modified Janemann probe (outer diameter, 0.7 or 1.1 mm), endoscopic examination is now possible in adults and children. The advantage of endoscopic examination is direct visualization and precise location of the lacrimal drainage system and its mucous membranes. The decision regarding whether a DCR, opening the stenosis with a laser, or gradual dilation is the most appropriate technique can be made with the help of the endoscope. With this method improved diagnostic efficiency and a more appropriate choice of surgical procedure can be expected. Encouraged by the easy handling of the miniendoscopes, we tried to find a laser source that is small enough to pass through the endoscope and powerful enough to cut bone to create a bony window of at least 5 mm in diameter. Based on the reports of Levin and Stromogipson\textsuperscript{9} and Dutton and Holck,\textsuperscript{5} we used the KTP laser on cadaver heads. From this experience we started to treat patients with a combination of lacrimal endoscopy and the KTP laser.

With this technique the laser is inserted into the lacrimal sac and points toward the lateral nasal wall, which means that penetration into the orbit and protrusion of fat can be avoided. In all our patients we were able to create a bony window of $5 \times 5$ mm with 5 to 10 W of energy. No complications, such as bleeding or infection, occurred. The technique can be performed under general or local anesthesia as day-case surgery. This procedure is faster than conventional endonasal DCR. Eighty-three percent of our patients had complete resolution of epiphora, and 6 patients required reoperation after 12 months of follow-up. The success rate of 83\% must therefore be compared with a 90\% success rate of the conventional external DCR, but in our opinion justifies use of this newly developed surgical technique to gain more experience and a larger patient collective. As described by Hartikainen et al,\textsuperscript{14} the initial success rate decreases from 90\% to 60\% after 1-year follow-up; therefore, a longer follow-up is necessary for a final judgment of this technique.

**CONCLUSIONS**

Endolacrimal KTP laser-assisted DCR is a minimally invasive and safe procedure that can be performed under local anesthesia. Using a miniendoscope for lacrimal endoscopy helps to identify the precise site of the stenosis. In our series of 78 patients we achieved a 83\% success rate after 1-year postoperative follow-up, a rate that is better than that of studies using laser-assisted DCR without miniendoscopes for lacrimal endoscopy.

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**REFERENCES**


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