Endoscopic laser recanalisation of presaccal canalicular obstruction

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Abstract

***Aim*—To document the results of erbium (Er)-YAG laser treatment in presaccal canalicular obstruction in combination with the use of a flexible endoscope.**

***Methods*—For the first time an Er-YAG laser (Schwind, Sklerostom) was attached to a flexible endoscope (Schwind, Endognost) and used to recanalise a stenosis of the upper, lower, or common canaliculus. In 17 patients (mean age 41.5 (SD 11.9) years), 19 treatments (two bilateral) were performed. In all cases the scar was observed using the endoscope and was excised by laser ablation. A silicone intubation was performed in all cases. In addition to the endoscopy an irrigation was performed to prove the intactness of the lacrimal pathway system after laser treatment.**

***Results*—Membranous obstructions with a maximum length of 2.0 mm (14 procedures) in the canaliculus were opened easily using the laser, and the silicone intubation was subsequently performed without difficulty. Scars thicker than 2.0 mm could not be opened safely without canaliculus penetration (five procedures). Irrigation was positive in all cases up to the end of a 6 month period, providing the tubes remained in place. The maximum follow up is now 17 months (minimum 8 months) and in 16 cases (84.2%) the canaliculi are still intact.**

***Conclusion*—Endoscopic laser treatment combined with silicone intubation enables us to recanalise presaccal stenoses of canaliculi under local anaesthesia up to a scar thickness of 2.0 mm. Best results can be achieved in cases where much tissue can be saved. Under such conditions this procedure can substitute for more invasive surgical techniques, especially a conjunctivo-dacryocystorhinostomy (CDCR).**

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Different aetiologies such as congenital lacrimal system atresia, eyelid trauma, scarring following previous lacrimal or tumour surgery, and, most often, chronic inflammatory fibrosis are responsible for a canalicular stenosis or obstruction.

Depending on the localisation of the scar, a variety of surgical intervention methods for reconstructing the presaccal lacrimal pathways have been published.

A simple punctum stenosis may be reopened by retrograde pigtail probing and by excising scar tissue, followed by a one snip procedure and silicone ring intubation.[1–4]

In case of a circumscribed canaliculus stenosis, the scars may be removed by excising the scar tissue and by anatomising the canaliculus with microsutures or fibrin sealing. In stenosis of a common canaliculus, a retrograde probing from the lacrimal sac will be necessary. After opening the lacrimal sac as in an external dacryocystorhinostomy (DCR) procedure, the internal opening of the common canaliculus may be detected microscopically and a dissection of the scars can be performed following retrograde probing.[5–12] In severe cases, where the complete proximal canalicular system is scarred, only a conjunctivo-dacryocystorhinostomy (CDCR) or some other type of bypass surgery can be performed.[5 13–17] All these surgical procedures are very difficult to perform and do not have good prognoses.[18–20]

Use of the latest development in laser fibres, with a diameter of 350 μm, coupled with a flexible microendoscope of 0.5 mm, allows the insertion into a modified Bowman probe of 1.1 mm outer diameter, which is introduced into the canaliculus. This new technical achievement makes the laser excision possible under direct visual control. For the first time this system has been used to treat presaccal stenosis.

Methods

Since summer 1996 the authors have performed 19 laser canalicular recanalisations in 17 patients (mean age 41.5 (SD 11.9) years, range 19–65 years). All had suffered from epiphora for between 2 and 14 months (mean 6.8 (3.5) months). Each patient was irrigated preoperatively and a lacrimal endoscopy of the pathway system was performed in order to determine whether the pathways were completely obstructed or only severely narrowed. None of the patients had had previous surgical intervention for canaliculus stenosis. Only those cases where the lower or common canaliculus had been affected were treated.

Local anaesthesia consisted of lignocaine with adrenaline, which was applied transcutaneously in the medial part of the eyelids and the lacrimal sac area. A modified double V-shaped Bowman probe with three conus openings at the upper end, containing the flexible endoscope and the laser fibre in addition to the irrigation channel, was inserted into the canaliculus. The probe was fixed to the hand piece of the laser. The outer diameter of the probe is 1.1 mm, small enough to insert it into a canaliculus. The endoscope (Schwind, Endognost) has a diameter of 0.5 mm, consisting of 3400 optical and 180 light fibres with an opening angle of 70°. It was con-

Figure 1 The laser hand piece (Schwind) with the fixed sapphire laser fibre of 350 µm.

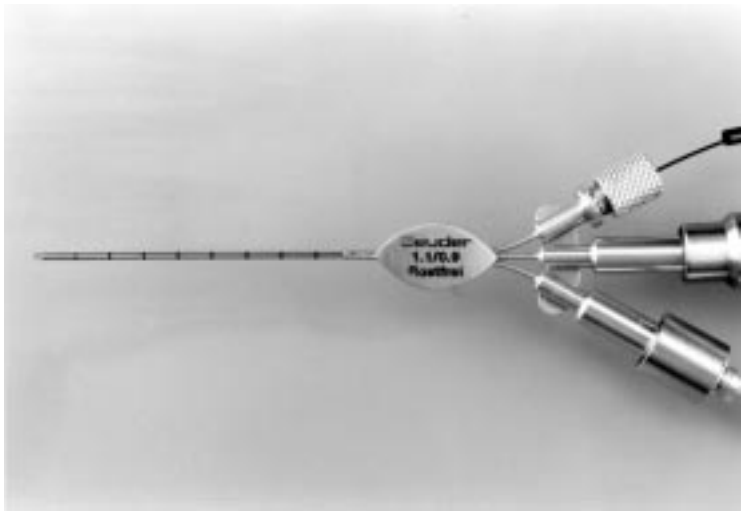

Figure 2 The modified Bowman probe (Geuder) with 1.1 mm outer and 0.9 mm inner diameter. At the upper end the connection for the endoscope, in the centre the laser fibre and at the third opening the syringe may be attached. The marks in a range of 5 mm are clearly detectable.

nected to a camera and a monitor which makes recording of the procedure possible. This fibre is inserted through the right channel of the probe. The Er-YAG laser (Schwind, Sklerostom) generates a laser beam of 800 nm and works in pulsed mode with 2 Hz, allowing a variable energy of 50–200 mW at the tip of 350 µm fibre. The sapphire fibre was fixed to the hand piece of the laser (Fig 1) and located in the central channel of the probe. The third opening of the Bowmann probe was preserved for irrigation (Fig 2). With continuous irrigation of saline solution, the stenotic membrane and the tip of the laser fibre are visible by means of the attached endoscope. After reaching the blockage, laser energy of 100 mW was applied until the stenotic part had been excised. The ablation rate of one shot was 10–20 µm. Depending on the scar thickness it took 10–20 repetition shots to penetrate the stenotic tissue. Care was taken not to penetrate the walls of the canaliculus, thus preventing via falsa. When the distal lumen of the canaliculus or the lacrimal sac had been reached, it was observed and a positive irrigation confirmed the successful opening of the scarred canaliculus and an intact nasolacrimal duct. The thickness of the stenotic part cannot be determined preoperatively, but may be estimated by observing the marks at the insertion point of the Bowman probe after penetration of the obstructed canaliculus. Finally, a silicone intubation was performed either in the form of a ring (in lower canaliculus cases) or monocanalicularly (in bicanalicular obstructions, where only the lower canaliculus was treated) by means of a Monoka[21] or bicanalicular silicone intubation (in common canaliculus cases) using a 0.65 mm silicone tube. The entire procedure, including silicone intubation takes about 30 minutes.

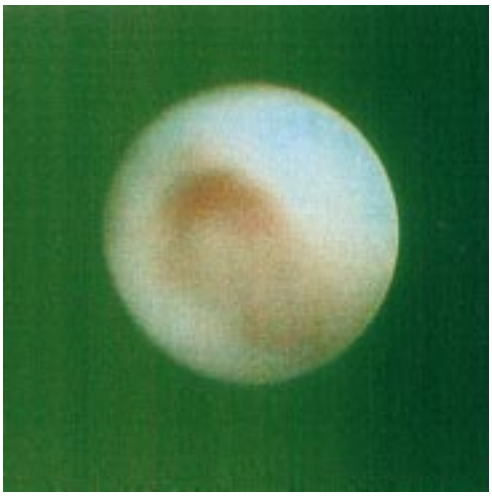

Figure 3 Scarred lower canaliculus with bleeding after irrigation.

The tube is left in place for about 6 months (depending on further developments).

Detumescent drops and antibiotic drops, each three times daily were prescribed for 2 weeks and 1 week respectively.

Results

In six cases the reason for the stenosis was chronic inflammation, in two cases a severe trauma of the eyelids proved to be the cause; in a further two cases repeated lacrimal probing had been performed preoperatively and in nine cases no particular reason could be found.

In seven cases, preoperative irrigation revealed a functional relative stenosis, which meant that high pressure irrigation was possible, whereas under physiological conditions an epiphora would have occurred. A total blockage of the system was found in the remaining 12 cases. Microendoscopy showed a lacrimal obstruction in six bicanalicular, eight lower canalicular, and five canaliculus communis cases.

Six cases presented a thin membranous stenosis, four involved a stenosis of the lower canaliculus (Fig 3) and two of the common canaliculus, which required only a few laser shots to open the obstruction. In all these patients a canalicular penetration could be safely avoided. Eight cases showed an obstruction of the canalicular system up to 2.0 mm (two bicanalicular, three lower canaliculus, and three common canaliculus), which needed 20–30 laser shots to penetrate the obstruction.

Figure 4 Lower canaliculus with silicone tube splinting the reopened passage after Er-YAG laser treatment.

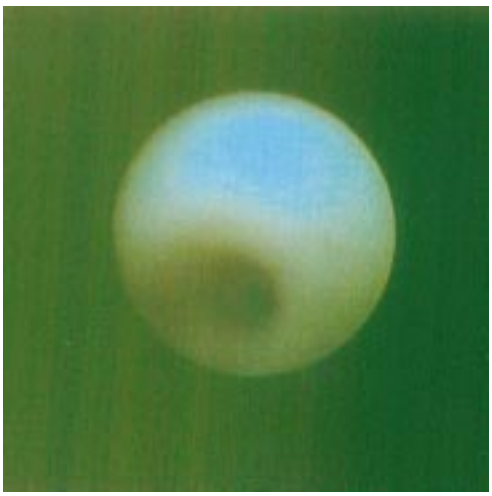

Figure 5 Recanalised lower canaliculus as in Figure 4 after tube removal.

Only in one of these cases did a penetration of the upper canaliculus to the pericanalicular tissue occur (trauma case). In five cases a scar of more than 2.0 mm (three lower canaliculus, two common canaliculus) was assessed. These cases required more than 40 laser shots and a penetration was unavoidable in all cases. It took about 10–20 seconds for 20–50 laser applications of 130 mJ to penetrate the blocked system. The entire procedure, including silicone intubation, took about 30 minutes.

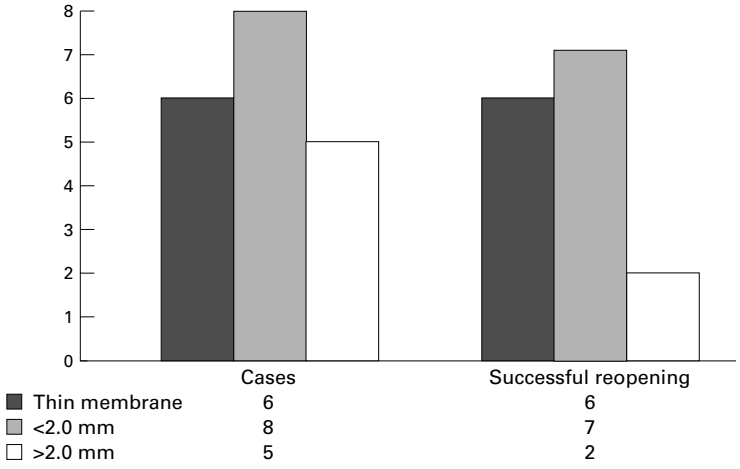

Figure 6 Success rate of laser reconstruction.

For all patients we succeeded in reaching the distal lumen of the canaliculus or the lacrimal sac. In one stenosis of less than 1.0 mm, slight bleeding occurred in one procedure; in dealing with stenoses over 1.0 mm, bleeding occurred in 70%. Intubation was possible in all cases. The mean follow up period is now 14 months. During the 6 month postoperative period while the lacrimal system was splinted by the silicone tubes (Fig 4), the lacrimal pathways were rinsable in all patients except one, who lost the silicone tube 2 weeks after the operation. After removal of the tubes 6 months postoperatively (Fig 5), all remaining 18 cases were rinsable. Three patients again suffered from epiphora within 4–12 weeks after tube removal. All these patients had had a stenosis of more than 2.0 mm (two canaliculus communis and one lower canaliculus). The results of successful treatment are detailed in Figure 6.

Discussion

Since we have been using lacrimal endoscopy in our outpatient department for 3 years in the field of lacrimal diagnosis,[22 23] the next logical step was to develop a surgical device which could be used in combination with this mini-endoscope.

A number of patients undergoing lacrimal drainage surgery needed more sophisticated investigations than mere syringing and probing to determine the location of an obstruction and the nature of surgery. The role of dacryocystography has been emphasised in recent years as a diagnostic tool.[20 24 25] This is a very expensive method and achieves best results in postsaccal stenotic obstructions. Nevertheless, the endoscope enables direct visualisation of the entire lacrimal duct system.[22 26–28] Therefore, we use this device only for diagnosis of stenotically obstructed canalicular systems.

Depending on the location of a presaccal stenosis various surgical procedures have been suggested. Lid tissues and sometimes the lacrimal sac have to be dissected and the embedded canaliculus with scarred tissue has to be excised. The stump of the canaliculus needs to be reattached to the common canaliculus or the lacrimal sac. Vein and mucous membrane transplants have also been reported for use in reconstructing a blocked canaliculus.[29 30] All other procedures require a bypass of the proximal lacrimal duct system. The most common one is conjunctivo-dacryocystorhinostomy. In this procedure the aim is to establish a direct connection between the conjunctiva, the lacrimal sac, and the nasal mucosa, bypassing the physiological lacrimal duct system without reconstructing the canaliculi.

In a 16 year study of 75 patients, Steinsapir *et al* made no attempt to reconstruct a canalicular system if less than 5 mm of both proximal canaliculi remained open.[18] Even Welham and Gutthof[19] and Hurwitz and Rutherford[20] concluded that if there is less than 8 mm of intact canaliculus, reconstructive pro-

cedures become difficult to perform and have a low success rate.

Hurrwitz and Rutherford suggested operating on the opened lacrimal system under direct visualisation rather than probing and leaving indwelling stents. The success rate of such a microsurgical reconstruction drops down from 77% in the case of a common canaliculus stenosis to 50% in the case of a proximal canaliculus stenosis. In cases of less than 8 mm intact canaliculus from the punctum, the success rate of reconstruction is less than 50%. In those cases a bypass is advised.[20] Laser procedures have been published for dealing with canalicular obstruction; these must deliver sufficient coagulation, a good cutting effect, and a laser beam, which can be sent through a very small fibre with a maximum effect on the top of the fibre and a minimum of lateral effect to protect adjacent tissue. The scarring stimulus should be kept to a minimum.

Dutton and Holck[17] reported on a holmium YAG laser treatment, whereby a new channel of 1 mm from the punctum to the lacrimal sac was created, substituting the Jones procedure with a significant improvement of 43% and a moderate improvement of 57%. Piaton and associates[31] treated canalicular stenosis by an Nd-YAG laser but without direct visualisation and subsequent silicone intubation. In a cadaver study Silkiss reported on duct recanalisation.[32] Our own experience during a 2 year period of diode laser treatment for certain postsaccal stenoses and reconstruction of canalicular obstruction without direct visualisation suggested an early shrinkage of the newly created channel to the lacrimal sac.[33] The Er-YAG laser provides all features which are mentioned above for a lacrimal surgery device. The most important advantage over all other laser systems is the small fibre which can be inserted in a common lacrimal probe in combination with the mini-endoscope. No other laser system currently available can be introduced in a small probing cannula with sufficient energy at the top of the laser fibre. The energy released at the top of the fibre is sufficient to cut soft tissue in order to recanalise obstructed canaliculi. On the other hand, it is not strong enough to create bony fistulas as is necessary in laser DCR procedures. Therefore this laser is limited to soft tissue obstructions, bony windows requiring a different type of laser. In canalicular reconstruction the Er-YAG laser can be used for all kinds of obstructions of the proximal canaliculus, irrespective of location, under direct visualisation.

From our data it is obvious that, although there were not many cases, the location of the obstruction is not an important factor for the success rate. The most important factor is the length of the stenosis. It is impossible to tell the thickness of an obstruction preoperatively; thus, an attempt can only be made to excise a circumscribed scar without penetration of the canaliculus. Scar thickness depends on the reason for the canalicular obstruction. The worst prognoses relate to trauma cases and the best results have been achieved in inflammation cases of short standing with small obstructed areas. Selection of patients for this procedure is very difficult, since the thickness of the stenotic part can only be estimated. This procedure can be performed in all cases with canalicular obstruction after discussion with the patient about the possible success as a first attempt to reopen a circumscribed stenosis in the lacrimal pathways. The laser surgery is a short procedure which can be performed under local anaesthesia and as outpatient therapy. The best success rate will be achieved in patients with inflammation of the lacrimal pathway system or conjunctivitis, who suffer from epiphora due to a lacrimal stenosis immediately following an inflammation. Therefore, we recommend syringing and probing all patients after inflammation of the lacrimal pathway system as an immediate follow up procedure. Should there be any stenosis or obstruction, a simple laser treatment can cure the majority of problems. These patients have the best chance for recanalisation of the lacrimal system. With patients who have a long standing history of epiphora and an endoscopically proved lacrimal obstruction, we discuss the possibility of this initial laser treatment, pointing out the uncertainty of the postoperative result. However, most patients prefer to have initial outpatient surgery under local anaesthesia. Since all other surgeries for canalicular reconstruction have unpredictable prognoses the initial approach using laser treatment is justified.

In all cases involving an obstructed area of less than 2.0 mm a safe excision was possible. The success rate was 84.2% in a mean follow up period of 10 months after silicone removal. Restenosis after tube removal occurred within 4–12 weeks. After this critical period no further obstruction could be detected. Nevertheless, in cases where an obstruction of more than 2.0 mm was present, the success rate decreased to less than 50%. In such cases a penetration of the proximal canaliculus system could be verified by endoscopy.

Thus, the most important aim in canalicular reconstruction is the formation of an open physiological pathway to preserve intact mucous membrane. Cases with only thin membranes or small obstructions of up to 2 mm can be expected to become recanalised and remain intact. Unfortunately, it is not possible to determine the length of a stenosis preoperatively. If one is familiar with the handling of the endoscope, obstructions can be detected and subsequent laser therapy can be performed as an initial approach in every canalicular obstruction. Depending on the length of the obstruction the success rate will decrease.

In conclusion, this procedure is very well suited for the reconstruction of lacrimal pathway obstructions, where the scarred tissue is not expected to be very thick; thus the excision can be performed within the canaliculus and without penetrating the duct system, providing a physiological recanalisation with a high rate of success.

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