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CLINICAL RESEARCH

Acquired External Punctal Stenosis: Surgical Management and Long-Term Follow-Up

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ABSTRACT *Purpose*: To introduce and assess the results of a long-term follow-up of a one-snip punctoplasty with monocanalicular stent (Mini Monoka) for acquired external punctal stenosis (AEPS) with and without associated internal punctal and canalicular stenosis. *Design*: Prospective non-comparative interventional case series. *Methods*: Thirty-five eligible patients (53 eyes) with AEPS underwent a horizontal one-snip punctoplasty and Mini Monoka tube insertion by or under supervision of a consultant Oculoplastic surgeon from June 1999 to May 2002. Diagnostic probing and irrigation were performed before operation and after operation at the last follow-up. Patients with canalicular obstruction, nasolacrimal duct stenosis and obstruction, and those with less than 6 months' follow-up were excluded. The Chi-square (X^2), Fisher's exact, Pearson correlation, and multiple logistic regression analysis tests, with 95% confidence interval when appropriate, were used for statistical analysis. *Results*: The age range was 39 to 90 years (mean: 67.2, SD: 11.8, SE: 2). Twenty-seven patients (77.1%) were female. There was a normal canalicular system in 21 (39.6%), lower canalicular stenosis in 10 (18.8%), and internal punctal stenosis in 22 (41.5%) eyes. Postoperative follow-up was from 6 to 41 months (mean: 18.5, SD: 9.2, SE: 1.2). There was a 77.4% complete functional success, 7.5% partial functional success, and 96.2% anatomical success at the last follow-up. The success rate was not significantly different between the eyes with and without preoperative internal punctal and canalicular stenosis ($p = 0.4$). The lower success rate was significantly correlated with a final abnormal probing and irrigation ($p < 0.01$). *Conclusion*: The use of a monocanalicular Mini Monoka stent together with a one-snip punctoplasty is helpful to prevent the recurrence of punctal stenosis in the healing phase and addresses the associated internal punctal and canalicular stenosis.

KEYWORDS Canalicular stenosis; Mini Monoka; punctal stenosis; snip punctoplasty; epiphora

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INTRODUCTION

Acquired external punctal stenosis (AEPS) can result in epiphora. Multiple procedures to overcome this disorder have been reported, such as: punctal

dilation, one-snip, two-snip, and three-snip punctoplasty [1], one-snip punctoplasty with punctal plug [2], laser punctoplasty [3], microsurgical punctoplasty [4], posterior punctectomy with intraoperative mitomycin C [5, 6], wedge punctoplasty [7], the punctum pucker procedure [8], cautery [9], and punctal punching [10]. Recurrent stenosis may occur as a result of scar formation during wound healing [4, 7]. Kristan and Branch [2] showed that a punctal plug can prevent scarring and wound healing at the opening site.

Different types of external punctal opening have been visually graded based on slit lamp examination [11]. Congenital absence of the punctum (atresia) has been defined as grade 0, severe punctal stenosis as grade 1, less severe punctal stenosis as grade 2, a normal punctal opening as grade 3, slit punctal opening less than 2 mm as grade 4, and a slit punctum of 2 mm and more as grade 5 (Table 1) [11].

We demonstrated the association of canalicular and especially internal punctal stenosis in more than 45% of AEPS [11]. Fein [9] found internal punctal stenosis in 9 cases with recurrence of epiphora after use of cautery to treat AEPS. A surgical procedure should, therefore, be able not only to treat the external punctal stenosis but also, at the same time, to address the internal punctal and canalicular stenosis.

Silicone stents are well tolerated, soft, flexible, and quite inert [12]. The Mini Monoka silicone monocanalicular stent (MM) (Fayet and Bernard, FCI, France) consists of a silicone tube with an outside diameter of 0.64 mm, a head (plug) that ensures stable meatic fixation of the probe, and a steel guide or a polypropylene thread guide. The head consists of an oval collarette, a hollow body linking the collarette to the bulb, and a bulb fixed to the silicone tube (Fig. 1).

TABLE 1 **Grading of the Different External Lacrimal Punctal Opening Sizes**

Grade	Clinical finding	Way to enter a #00 Bowman probe
0	No papilla and punctum (Punctal atresia)	Requires the surgical creation of a papilla.
1	Papilla is covered by a membrane (exudative or true membrane) or fibrosis and is difficult to recognize.	Requires a #25 needle, followed by a punctal finder and then standard punctum dilator.
2	Less than normal size but recognizable.	Requires a punctal finder and then a standard punctum dilator.
3	Normal	Requires a regular punctum dilator.
4	Small slit (<2 mm)	No need for intervention.
5	Large slit (≥2 mm)	No need for intervention.

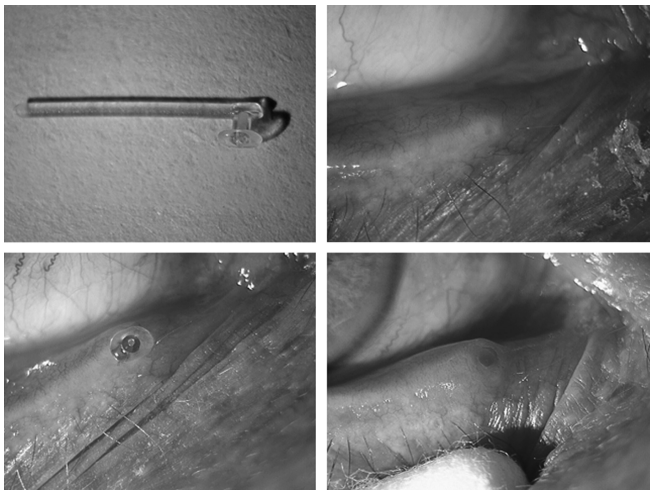

FIGURE 1 **Mini Monoka monocanalicular silicone tube (MM) (top-left); severe punctal stenosis (grade 1 punctal opening) (top-right); Mini Monoka tube inside the punctum and canaliculus (bottom-left); normal punctum (grade 3 punctal opening) 7 weeks post one-snip punctoplasty and MM just after removing the tube (bottom-right).**

The purpose of this prospective study was to introduce a procedure to treat AEPS with and without associated canalicular and internal punctal stenosis and to assess the long-term anatomical and functional success of this procedure. To the best of our knowledge, this is the largest prospective study that evaluates the treatment and long-term results of patients with AEPS.

METHODS

In a prospective non-comparative interventional case series, 53 eyes of 35 consecutive patients with severe (grade 1 punctal opening) and less severe (grade 2 punctal opening) AEPS [11] with and without associated internal punctal and canalicular stenosis were found eligible for this study. Punctal stenosis was detected on slit-lamp examination and a diagnostic probing and the diagnosis of canalicular stenosis was made based on a diagnostic probing test [11]. The patients underwent horizontal one-snip punctoplasty and MM insertion under local anesthesia by or under supervision of a consultant Oculoplastic surgeon from June 1999 to May 2002. Patients with previous eyelid and/or

lacrimal surgery, lump overlying or involving the punctum and/or other parts of the tear drainage system, complete upper lacrimal system obstruction (canaliculi and common canaliculus) on diagnostic probing, nasolacrimal duct stenosis or obstruction on irrigation test, and less than 6 months of follow-up were excluded. Patients with symptomatic AEPS after treating the blepharitis were included. Patients with AEPS associated with ectropion were also included. The different surgical options were explained and an informed consent was obtained. Diagnostic probing of the upper lacrimal drainage system and irrigation of the nasolacrimal duct was initially performed as explained in the previous study [11].

Bowman [13] and Arlit [14] introduced a horizontal one-snip punctoplasty in the mid-19th century. Based on the previous experience on insertion of the MM, we found that a very small (2 mm) horizontal one-snip punctoplasty provides better insertion and fixation of the MM. After instillation of a topical anesthetic drop (Benoxinate 0.4%, Chauvin Pharmaceuticals Ltd, UK) and injection of approximately 1 ml local anesthetic (lidocaine 2% with adrenaline 1/80000) around the punctum and canaliculus, a horizontal one-snip was performed with a sharp-tip Westcott scissor from the area of the ampulla horizontal to the lid margin in a medial fashion similar to the second incision in a two-snip procedure. In some cases this was done under the operating microscope. The MM was cut 2 mm more than the recorded distance of the canalicular stenosis. In case of total narrowing of the canaliculus, internal punctal stenosis and normal probing, the length of the MM was the distance from the punctum to the sac. The cut edge of the MM was grabbed with a toothed forceps and introduced into the ampulla. It was then advanced into the canaliculus. In case of internal punctal and canalicular stenosis, it was necessary to use more force to advance the MM through the stenosis. The head of the MM was fixed onto the ampulla with the forceps (Fig. 1). Any associated ectropion was repaired with a Lazy-T procedure [15] during the procedure. The patients were instructed to take chloramphenicol 0.5% (Cusi Ltd, UK) and Maxidex (dexamethasone 0.1%, Alcon) drops, four times a day for one week. Follow-up was arranged in 6 weeks for removal of the tube. The MM was removed under topical anesthesia (Benoxinate 0.4%) with a pair of forceps (Fig. 1). The patients were reviewed at least 6 months following this with the exception of any recurrence. The last follow-up examination included diagnostic probing and irrigation. Patients with recurrence of their epiphora also underwent diagnostic probing and irrigation at the time of re-referral, and this was recorded as the last follow-up. "Complete success" was defined as complete disappearance of the symptoms. "Partial success" included all patients who had improvement of the symptoms. "Anatomical success" was defined as a punctal opening grade of 3 (normal size of punctum), 4 (<2 mm slit punctum), or 5 (≥2 mm slit punctum) [11]. Demographic data, laterality, underlying causes, type and duration of the preoperative symptoms, patients' symptoms at the time of the MM removal, last follow-up time, pre-operative and last follow-up punctal grading, diagnostic probing and irrigation findings, and the time interval for removal of the MM were studied using the software SPSS MS Window Release 9.0, Chicago. The Chi-square (X^2), Fisher's exact, Pearson correlation, and multiple logistic regression analysis tests, with 95% confidence interval when appropriate, were used for statistical analysis.

RESULTS

The age range was 39–90 years (mean: 67.2, SD: 11.8, SE: 2). Twenty-seven patients (77.1%) were females. The right lower punctum was involved in 8 patients (22.9%), left lower punctum in 9 patients (25.7%), and both lower puncti were involved in 18 patients (51.4%) (grade 1: 81% and grade 2: 19%). Both lower and upper puncti (grade 2) were involved in 1 eye (1.9%) due to systemic 5-fluorouracil chemotherapy.

The presenting symptom was tearing in 33 eyes (62.3%) and tearing with eye discomfort in 20 eyes (37.7%). Although the patients had had symptoms for long periods of time, their symptoms had been severe for 2–18 months (mean: 5.2, SD: 3.5, SE: 0.4) prior to referral. The underlying cause of AEPS was chronic blepharitis (infectious, seborrheic, mix, or rosacea) (30 eyes, 56.6%), ectropion (12 eyes, 22.6%), unknown (9 eyes, 17%), systemic 5-fluorouracil (one eye, 1.9%), and anti-glaucoma drops (Latanaprost, one eye, 1.9%). Medial ectropion was found in 8 (15.1%) and total ectropion in 4 (7.5%) lower eyelids.

On preoperative diagnostic probing, there were normal canaliculi in 21 (39.6%), associated lower canalicular stenosis in 10 (18.8%, 5–9 mm from the punctum), and associated internal punctal stenosis in 22 eyes (41.5%). The MM was removed 6–9 weeks following the

TABLE 2 **Comparison of the Functional Success Rates of the One-Snip Punctoplasty and Monocanalicular Stent in 53 Eyes with Acquired External Punctal Stenosis with and Without Associated Canalicular Stenosis**

	Functional success (%)	Statistical analysis
At the time of stent removal (mean = 6.5 weeks, SD = 0.8, SE = 0.1)	51/53 (96.2)	Pearson correlation, 95%CI = 0.01–0.02, r = 0.47, p = 0.01
Last follow-up (mean = 18.5 months, SD = 9.5, SE = 1.2)	45/53 (85)	
Normal preoperative canaliculi	19/21 (90.4)	Fisher's exact test, p = 0.4
Preoperative canalicular stenosis	26/32 (81.2)	
Normal canaliculus at last follow-up	42/46 (91.3)	Fisher's exact test, p = 0.007
Canalicular stenosis and obstruction at last follow-up	3/7 (42.8)	
Normal nasolacrimal duct at last follow-up	42/43 (97.6)	Fisher's exact test, p = 0.000
Nasolacrimal duct stenosis and obstruction	3/10 (30)	
Punctal opening at last follow-up:		
Grade 2 (less severe stenosis)	0/2 (0)	95%CI = 0.02–0.03,
Grade 3 (normal)	25/28 (89.2)	df = 3, X^2 = 12.28,
Grade 4 (slit punctum <2 mm)	17/19 (89.4)	
Grade 5 (slit punctum ≥2 mm)	3/4 (75)	p = 0.02

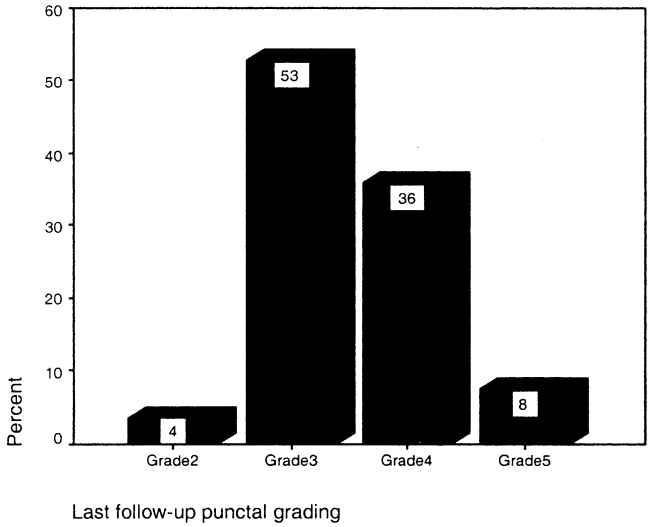

FIGURE 2 **Grade 2 (less severe punctal stenosis), 3 (normal punctum), 4 (slit punctum <2 mm), and 5 (slit punctum ≥2 mm) of punctal opening at the last postoperative follow-up (6–41 months, mean: 18.5) following a one-snip punctoplasty and Mini Monoka tube insertion in 53 eyes with acquired external punctal stenosis.**

operation (mean: 6.5, SD: 0.8, SE: 0.1). Premature stent loss (3–6 weeks after operation) occurred in 5 (9.4%) eyes. Eight patients reported temporary ocular surface discomfort after operation, which was managed with topical lubricant in a few days. No other complications related to the MM were seen.

After removal of the stent or premature stent loss, all eyes had anatomical success (grade 3, 30%; grade 4, 51%; and grade 5, 19%). The immediate complete and partial functional success rates, after tube removal, were 71.7% (38 eyes) and 24.5% (13 eyes), respectively (Table 2). Postoperative follow-up was 6–41 months (mean: 18.5, SD: 9.2, SE: 1.2). Three eyes with immediate partial functional success developed complete functional success and six eyes had failure at last follow-up. There was 77.4% (41 eyes) complete functional success, 7.5% (4 eyes) partial functional success (Table 3), and 96.2% (51 eyes) anatomical success (Fig. 2) at the last follow-up.

There were four eyes (7.5%) with internal punctal stenosis and three (5.7%) with obstructions at the last follow-up probing. None of them had a normal probing test preoperatively. Nasolacrimal duct stenosis in four (7.5%) and obstruction in three (5.7%) eyes was found at the last follow-up irrigation test. Five of these had an abnormal probing test preoperatively.

The age, gender, laterality, presenting symptoms, duration of symptoms, underlying causes of AEPS,

TABLE 3 **Multiple Logistic Regression Model to Assess the Effect of Probing and Irrigation Results at Last Follow-Up on the Success Rate of One-Snip Punctoplasty and Mini Monoka Tube Insertion**

	Coefficient (β)	Standard Error	Wald X^2	p-value	Odds ratio	95% confidence interval
Intercept	−0.96	1.06	—	—	—	—
Probing	0.86	1.37	0.39	0.52	2.3	0.16–35.1
Irrigation	3.89	1.34	8.40	0.004	49.3	3.5–688.8

associated lower lid ectropion surgery, severity of the punctal stenosis (punctal opening grade 1 and 2), premature stent loss (complete success rate: 100%), different postoperative follow-up times, and the grade of postoperative punctal opening (3, 4, and 5) at the time of stent removal did not have a significant effect on the functional success rate in the Chi-square and Fisher's exact tests ($0.1 < p < 1$).

Neither of the two eyes with grade 2 puncti at the final follow-up had functional success, which was significantly different from the success rate in grades 3, 4, and 5 (Table 2). In one of the eyes with a grade 2 punctum at final follow-up, there was an associated internal punctal obstruction and in the other there was a nasolacrimal duct stenosis.

A decreased functional success rate was correlated with internal punctal stenosis and obstruction (Pearson correlation test, 95%CI = 0.003–0.006, $p = 0.005$, $r = 0.45$). Correspondingly, there was a strong correlation (Pearson correlation test, 95%CI = 0.000–0.000, $p = 0.000$, $r = 0.74$) between a lower functional success rate and nasolacrimal duct stenosis and obstruction at the last follow-up. The results of the irrigation test had more impact on the final functional success than those of the probing test (Table 3).

DISCUSSION

The basic principles in the treatment of punctal stenosis include creating an adequate opening, maintaining the punctal position against the lacrimal lake, enhancing tear access from the lacrimal lake to the punctal opening, and preserving the function of the lacrimal pump.

Historically, the one-snip procedure was introduced by Bowman [13] in 1853 and by Arlit [14] in 1874. Both advocated incision of the horizontal canaliculus rather than the ampulla. Later, Jones popularized the one-snip procedure involving incision of the ampulla [16]. Although the one-snip procedure has been the most widely used, both in our experience [5, 7] and in the published literature [2, 5, 8, 9], recurrent punctal stenosis may be related to healing of the cut edge. To address this problem, adjunctive intra-operative mitomycin C [5, 6], punctal plug insertion [2], different punches [1, 7, 10] and various punctoplasty procedures [4, 8] have been introduced. None of these have addressed the associated internal punctal and canalicular stenosis. We found 96.2% anatomical success and 84.9% functional success among 53 eyes with AEPS and different underlying causes. There was a preoperative associated canalicular and internal punctal stenosis in 60.5%. It seems that reduced tear flow through the lacrimal drainage system and underlying causes in AEPS may predispose to stenosis and obstruction in the canaliculus and NLD [11]. Ma'luf et al. [5] reported functional success rates (symptom free and improvement) of 96% (anatomical success: 100%) and 76% (anatomical success: 81%) after a posterior punctectomy with and without adjunctive intra-operative mitomycin C, respectively ($p < 0.05$). Their patients, however, had normal probing and normal lower lid position. Edelstein and Reiss [7] performed a wedge punctoplasy (Reiss punctal punch) on 35 eyes with AEPS. They did not perform diagnostic probing and irrigation pre- and postoperatively. After a mean follow-up of 12 months, a 95% anatomical success and 92% symptomatic relief was achieved [7]. They recommended a supporting stent (silicone intubation) to achieve a permanent opening [7]. Kristan and Branch [2] inserted a temporary punctal plug after a one-snip punctoplasty and achieved a symptomatic improvement in all of 25 AEPS cases without associated canalicular or NLD stenosis. A 96% functional and 100% anatomical success rate was achieved with a microsurgical punctoplasty in 28 AEPS cases with normal probing and irrigation [4]. A Mini Monoka tube was inserted to address the severe external punctal stenosis and associated canalicular stenosis in patients with ectropion. A simple dilation and correction of ectropion would resolve the problem in temporary punctal stenosis associated with ectropion.

We performed a one-snip punctoplasty with Mini Monoka tube insertion to prevent re-stenosis during the healing phase and tried to address the associated internal punctal and canalicular stenosis simultaneously. The success rate was not different (Fisher's exact test, $p = 0.4$) in the eyes with normal pre-operative (90.4%) and abnormal preoperative (81.2%) probing tests. This suggests that the MM helps to provide a similar long-term success in AEPS with and without associated internal punctal and canalicular stenosis.

The lower success rate in the eyes with abnormal final follow-up probing (internal punctal stenosis and obstruction) and irrigation (nasolacrimal duct stenosis and obstruction) tests was statistically significant (X^2, $p < 0.05$). The effect of the abnormal irrigation test was more significant in a multiple logistic regression analysis. Fein [9] reported that nine (37%) recurrences in their

series had internal punctal stenosis. Stenosis might be expected at the beginning and end of each individual segment of the lacrimal excretory system [9]. Stenosis at any junction point in the system may indicate future stenosis at other junction points [9].

There were five (9.4%) premature stent losses and no other serious complications, such as persistent corneal erosion, bacterial keratitis, or lid infection [17, 18] in our study. Premature stent loss has been reported as often as 28% in one study [17]. We found slit puncti in 44% (grade 4: 19 eyes, 36% and grade 5: 4 eyes, 8%) at the last follow-up. Hurwitz [1] pointed out that treatment of a slit punctum is usually not necessary. The functional success rate was not significantly different between the eyes with grade 3, grade 4, and grade 5 puncti in our study.

In conclusion, the MM can address two problems in patients with AEPS. The first is to prevent reunion and scarring of the punctum during the healing phase and the second is to address the associated internal punctal and canalicular stenosis. There were no controls in this study. On the second role of MM, one may argue that opening of the external punctum alone with restoration of the tear flow may reverse the associated tear drainage stenosis without intubation. A clinical trial to compare the success rate with and without the use of MM in the treatment of AEPS associated with canalicular and internal punctal stenosis would seem helpful.

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