

CLINICAL SCIENCE

Surgical punctal occlusion: a prospective study

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Aims: To assess the outcome of a surgical punctal occlusion technique.

Method: Prospectively, 11 consecutive patients (26 puncta) with severe dry eyes recalcitrant to maximal medical therapy underwent permanent punctal occlusion at a tertiary eye care centre between January 1999 and December 2000. The epithelium of the punctum and the vertical portion of the canaliculus was removed with a corneal rust ring burr. The bared punctum-canalculus complex was closed with a 6-0 chromic suture. Success was measured by the complete functional occlusion of the punctum, tear function tests, and patients' response.

Result: Five males and nine females, aged 26–77 enrolled in the study with three patients later excluded. As of November 2001, the remaining 11 patients had follow up ranging from 14 to 34 months (mean 24 months; median 24 months). 24 puncta (or 92%) remained occluded, including four puncta which showed anatomical reopening. Seven out of 11 patients (63.6%) stated they had symptomatic improvement regardless of their objective findings.

Conclusion: This technique resulted in a 92% permanent occlusion of the puncta and compared favourably with other reported techniques. Punctal occlusion does not appear to correlate well with Schirmer tests, the frequency of lubrication, and/or subjective feelings in these patients.

The management of severe dry eyes continues to challenge clinicians. Current available treatment is limited to symptomatic relief. Essentially, two approaches are used: constant lubrication and conservation of existing tears. In patients who do not find symptomatic relief despite medical therapy and maximal lubrication, permanent punctal occlusion is often indicated.^{1–8} Conventional methods of permanent punctal occlusion included cautery, laser, and various surgical techniques.^{3–8} In an attempt to enhance the successful occlusion rate and to determine if any correlation existed between a successful occlusion and objective and/or subjective findings, the authors modified a simple technique and studied prospectively 11 patients with 26 puncta over the past 34 months.

MATERIALS AND METHODS

This study was approved by the research council and human investigative committee of King Khaled Eye Specialist Hospital. From January 1999 to December 2000, 22 patients were referred to the authors of the oculoplastic service of King Khaled Eye Specialist Hospital for consideration of permanent punctal occlusion. Fourteen of these patients enrolled in the study. These patients had already been diagnosed as having severe dry eyes by anterior segment specialists and were recalcitrant to maximal lubricant therapy. The aetiology of dry eyes remained unknown in nine patients. In five patients it was confirmed as a part of Sjögren's syndrome. There were five males and nine females, aged 26–77. In all patients, both eyes were symptomatic. The study protocol was carefully explained to the participants and informed consent was obtained.

Preoperative examination by the authors before surgical occlusion included Schirmer I and II tests, fluorescein and rose bengal staining of the cornea and conjunctiva, in addition to checking visual acuity, biomicroscopy, and a thorough examination of the eyelids and adnexae. The patient's lacrimal system was also probed and irrigated in the office to verify its patency. The preoperative and postoperative frequency of their lubricant application were recorded.

Patients were excluded from the study if they had already had any previous surgical punctal procedure, or if an

obstructed lacrimal system was found during office probing and irrigation, punctal ectropion, or if their documentation or follow up were inadequate.

Surgical technique

The procedure was performed under local anaesthesia. A drop of topical anaesthetic was instilled in the eyes. A tiny amount (about 0.1 ml) of 2% Xylocaine with adrenaline was injected in the tissues surrounding the punctum and the vertical portion of the canaliculus. The surgical field was prepared and draped in sterile manner.

A corneal rust ring burr with a 0.6 mm diameter (Grieshaber, Switzerland) was used to remove the epithelium from the punctum and the vertical portion of the canaliculus to a depth of 2 mm. Usually, the stripped epithelium was clearly visible, wrapped around the burr. Minimal oozing was observed and no cautery was used. Particular attention was paid to the complete removal of the punctal epithelium. A simple interrupted 6-0 chromic suture with a 3/8 circle reverse cutting needle was used to bring the raw surfaces of the vertical portion of the canaliculus together. It was placed parallel to the lid margin to avoid corneal irritation (Fig 1).



Figure 1 Under local anaesthesia, a corneal rust ring burr (0.6 mm diameter) is used to remove the epithelium of the punctum and the vertical portion of the canaliculus. A 6-0 chromic suture brings the raw surfaces together.

A small amount of gentamicin ointment was instilled in the operated eye with a cold compress application immediately following the procedure. Follow up appointments were scheduled at 1, 3, and 6 month postoperative intervals. Schirmer I and II tests, fluorescein, and rose bengal staining studies were repeated at these postoperative visits.

A question was asked of the patients at the three designated postoperative visits with a simple scoring system. They were asked if symptomatically they felt better (+1), the same (0), or worse (-1) following the procedure. Scores were added. Anyone with a total score of +2 or +3 beyond the 6 month period was considered symptomatically improved. Anyone with a score of +1 or lower was considered having no improvement. In addition, the preoperative and postoperative frequency of their lubricant application were recorded and reviewed.

RESULTS

A total of 14 patients enrolled in the study during the study period. One patient was excluded because she already had an obstructed lacrimal system preoperatively. Two other patients were excluded because of inadequate documentation and/or follow up. Only 11 patients (26 puncta) were included in this report. There were four males and seven females, aged 26–77. Nine patients had both lower puncta occluded and two patients had all four puncta occluded (in two different sessions). As of November 2001, follow up ranged from 14 to 34 months with a median of 24 months (average 24 months).

Out of the 26 puncta, 20 of them (76.2%) remained completely occluded to date. Additionally, there were four puncta in three different patients (two right lower puncta and two left lower puncta) which appeared open at first sight but were found to be actually occluded. In other words, a total of 24 out of 26 puncta (92%) remained completely occluded. In all of the patients, the chromic suture resorbed without causing any corneal problem. None of the patient developed subsequent epiphora.

Seven patients responded with a score of +2 and higher, giving this procedure a subjective success rate of 7/11 or 63.7%. Postoperative tear function tests showed a minimal increase in three patients including one patient who gave a postoperative score of +1. The frequency of lubricant usage dropped slightly in four patients, with three of them showing no change in postoperative tear production (Table 1).

DISCUSSION

Management of dry eyes has been a constant challenge to ophthalmologists. To date, it has been essentially limited to

symptomatic relief with either constant lubrication or preservation of existing tears.^{1–8} Permanent punctal occlusion is considered only if a patient with severe dry eyes fails to obtain relief despite maximal lubrication and other medical treatment aimed at correcting the underlying disease have been initiated.^{1–8} Once a punctum is (truly) permanently occluded, it is difficult to reverse the anatomical and functional blockage. Therefore, the surgeon must be extremely careful in selecting a candidate.

Before performing a procedure to occlude a punctum permanently, many authors suggested a trial of temporary punctal occlusion using various plugs.^{1–4} While this is prudent, one must keep in mind some of the intrinsic limitations of these devices and potential complications. More specifically, Groves and Glatt noted failure of collagen plugs to predict epiphora after permanent punctal occlusion.^{9,10} Redmond also pointed out some of the intrinsic limitations of these devices in making these predictions.¹¹ Virtanen *et al* noted that punctal occlusion induced only a relatively short lasting subjective and objective benefit for contact lens wearers.¹²

Known complications from these temporary devices include corneal irritation, erosion, allergic reaction, infection and migration, luxation, and disappearance of these plugs.^{1,3,4,13–15} Tissue glue has also been used as temporary measure.^{3,16,17} Even if these plugs happen to work well in some individuals, they are not designed as a permanent solution.

Silicone punctal plugs have been used in various conditions with varying degrees of success.^{1–4,12,15} Before considering permanent punctal occlusion, their application should be explored.

Permanent punctal occlusion can be achieved with cautery, laser, and surgery.^{3–8} Relatively low success rates were noted in the earlier reports using the cautery technique.^{3,18–21} Knapp *et al* studied two different cautery techniques. They found a deep cautery application more effective than a superficial one.⁵ Bilateral dacryocystitis has been reported as a rare complication of permanent punctal occlusion using cautery technique.²²

Nelson and Reed studied argon laser versus thermal cautery for punctal occlusion in a small number of dogs and cats.⁷ Benson *et al* and Vrabec *et al* found punctum occlusion by argon laser has a high failure rate.^{6,8} The cost associated with laser technique is known to be higher than that of the conventional methods.

Several surgical techniques have been described but so far none of them has been studied prospectively.^{3,23–27} This is probably due to the small number of patients who need a permanent punctal occlusion. Anticipating such limitation, the authors of the current study planned to prospectively study only one single surgical technique and its outcome.

Table 1 Patient details and treatment

Patient No	Age	Sex	Diagnosis	Procedure done to				Procedure date	Follow up (months)	Re-open postop	Subjective score	Schirmer I and II	Lubricant frequent
				RUL	LUL	RLL	LLL						
1	71	M				C	C*	Jan 99	34	1 Month	1	Slight increase	Every hour to every 2 hours
2	63	F		C	C	C*	C	May 99	30	3 Month	1	Unchanged	Unchanged
3	77	M				C	C	May 99	30		3	Unchanged	Every hour to every 4 hours
4	64	M				C*	C*	May 99	30	3 Month	1	Unchanged	Unchanged
5	66	F	SJ			C	C	Sep 99	26		2	Unchanged	Unchanged
6	50	M				C	C	Nov 99	24		3	Unchanged	Every hour to every 2 hours
7	63	F				C	C	Jan 00	22		2	Unchanged	Unchanged
8	37	F	SJ	C	C	F	F	Feb 00	21	3 Month	1	Unchanged	Unchanged
9	44	F	SJ			C	C	Apr 00	19		3	Slight increase	Unchanged
10	67	F				C	C	Aug 00	14		2	Slight increase	Unchanged
11	26	F				C	C	Aug 00	14		3	Unchanged	Every hour to every 4 hours

C = closed completely; C* = appears re-opened but actually closed; F = failure, punctum re-opened; Sj = Sjögren's syndrome.

The principles of a successful permanent punctal occlusion include bringing together raw surfaces to heal either in the canaliculus or the punctum, or both. This study specifically addresses this issue. A controlled removal of the epithelium of the lacrimal drainage system from the punctum down to the ampullae is achieved with a corneal burr. A 6-0 chromic brings the raw surfaces together. Once the tissue heals, the occlusion is expected to be complete and permanent.

There are certainly many techniques that can create a raw surface in the canalicular system. There are also many suturing techniques and materials. The authors feel the use of a fine corneal burr allows better control than, for example, incising the canaliculus. Simple closure with a readily available absorbable suture material may find wider applicability and fewer corneal complications.

By biomicroscopic examination, 20 puncta in our study patients demonstrated complete occlusion. Additionally, there were four puncta, two in the right lower lid and two in the left lower lid, in three individuals which appeared open but were actually occluded. The left lower punctum of patient 1 was found to have reopened at the first month postoperative visit. Both lower puncta in patient 4, and the right lower punctum in patient 2 were found to have reopened at the third month postoperative visit. Complete occlusion of these puncta was verified by probing and a negative dye disappearance test. It gives this occlusion technique a 24/26 or 92% success rate, which compares favourably with previous reports.³⁻⁸

All of these re-opening were found in patients who enrolled early in the study. Initially, the importance of complete removal of epithelium of the punctum itself on the surface of the lid margin was not fully recognised nor was our technique quite refined.

Upon closer examination, these re-opened puncta were only gaping at the punctum. The vertical portion of their canaliculus was completely occluded about ½ mm beneath the surface. All of these puncta resisted dilatation and we were unable to insert the smallest probe in the canaliculus for more than ½ mm. In other words, despite the appearance of an opening on the surface, the lacrimal drainage system in these three patients was found completely occluded.

We first performed dye disappearance tests and obtained a negative result in these patients without taking into consideration their open upper puncta. We later repeated the tests with these puncta temporarily occluded. The tests remained negative, affirming the complete occlusion of the lower system. The negative test result may be attributed to either the low sensitivity of the test itself or the low capacity of the upper lacrimal drainage system in these particular patients, or both.

There was one patient whose lower puncta failed to occlude completely. This is patient 8, a 37 year old healthy female patient with Sjögren's syndrome. She had a good response (+1) initially with both lower puncta occluded with this technique. Surgical occlusion of both her upper puncta was performed with the same technique 3 months later. However, both of her lower puncta were noted to have re-opened at that time. Following the occlusion of her upper puncta, she did not feel any subjective improvement (giving subsequent scores of 0 and 0). Her tear function tests and the frequency of lubricant application remained essentially the same as preoperatively. No further surgery was performed for her.

It is difficult to explain the failure found in this patient. She was an otherwise healthy patient with Sjögren's syndrome. Her lower puncta were occluded surgically in early 2000. She was also cooperative and compliant. There appeared no unusual or forceful squeezing or pulling of her lower eyelids by history.

In this study, failures were found in the lower eyelids with an equal distribution of right and left side. There were altogether four upper puncta (bilateral in patients 2 and 8) occluded in this series. Statistically, we are more likely to encounter a failure in the lower eyelid. Furthermore, with

additional force applied to the lower lids constantly such as in squeezing to make oneself more comfortable and in instilling lubricant may account for the higher rate of failure in lower puncta. In order to counter this effect and improve surgical outcome, perhaps a vertical mattress suture or an additional suture may help.

The Schirmer I and II tests before and after the procedure showed a minimal increase in three patients (patients 1, 9, and 10). The increase was barely noticeable and not statistically significant. Preoperatively, the range of their Schirmer I tests of all the patients was from 3 mm to 12 mm with wide inter-personal variation and fluctuation from one visit to the next. The Schirmer II tests in all of the study patients ranged from 0 to 3 mm, with most of them nearing 0. It was difficult to measure any change with precision. Of the three patients demonstrating any observable increase, patient 1 gave a subjective score of +1 despite his decreased lubricant application frequency. Patient 10 gave a score of +2 while maintaining the same lubricant application frequency. Patient 9 gave a score of +3 despite being maintained on the same lubricant application schedule. No patient showed a measurable decrease in Schirmer tests, however. Similarly, the result of the rose bengal and fluorescein staining tests demonstrated that very little change occurred following this procedure. Given the limitation of the Schirmer tests, the quasiquantitative nature of the rose bengal and fluorescein staining tests, and the nature of the disease we are dealing with, this is not entirely unexpected.²⁸⁻³³

Our question with a simple scoring system was designed to avoid any cross cultural and interpersonal variations. In all, 63.7% of the patients in this study responded favourably to the treatment regardless of their objective findings. Given the very hot and dry environment in which these patients live, a positive response rate like this is indeed encouraging.

Four patients showed a decrease in the frequency of their lubricant application. Patients 1 and 6 were able to decrease their frequency from every hour to every 2 hours and maintain that schedule. Patients 3 and 11 were able to further decrease their application from every hour to every 2 hours and finally to every 4 hours and maintain that new schedule. Interestingly, patient 1 only gave a score of +1 despite the closure of his puncta and decrease of lubricant application frequency. One possible explanation was the patient's awareness the re-opening of his own left punctum.

Patients 5 and 7 gave a score of +2 despite no changes in their tear function and lubricant application frequency. By contrast, patients 2, 4, and 8 only gave a score of +1 with the same objective findings—that is, no changes in tear function and lubricant application frequency. As can be seen in Table 1, there is very little correlation between the patient's subjective score, their tear function tests, and their frequency of lubricant application.

Owing to the small sample size of the present study, it would be difficult to interpret many of the findings and the lack of a correlation between the objective findings and subjective responses. This notwithstanding, similar observations have been noted in some of the previous studies.^{5, 34-38} Some of these reports also showed that the re-opening of the punctum following cautery treatment was about 25%. Although no specific time frame was given when the re-opening was first noticed in these patients, it appeared to have happened during early follow up visit because most of these patients were re-occluded and they continued their participation in these studies.^{34, 35} A punctal plug was used in two of these reports. Spontaneous plug extrusion was noted as early as 2 weeks post-insertion and the theoretical probability of plug extrusion went up as time went on.^{36, 37}

In summary, it appears reasonable to perform a permanent punctal occlusion in properly selected patient with the technique described herein. The authors found this technique simple and effective. It achieved a 92% success rate in a complete occlusion in 11 patients (24 out of 26 puncta). Seven out

of the 11 patients (63.7%) reported symptomatic improvement regardless of objective findings.

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The authors do not have any financial interest in any of the instruments or medications used in this study.

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