

The Use of Argon Laser Punctal Stenosis in Patients with Contact Lens-Induced Dry Eyes

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Abstract

Objective: To determine the efficacy of argon laser punctal stenosis in patients with contact lens-induced dry eyes.

Methods: A retrospective review of 25 eyes of 13 patients who underwent argon laser punctal stenosis to improve their contact lens intolerance was performed. The mean age was 31 years (21-52) and 11 patients (85%) were female. The mean Schirmer I test was 15.2 (range, 3-35).

Results: All patients tolerated the procedure well. In 19 eyes, the treatment only involved the lower punctum, while in 6 eyes it involved both the upper and lower puncta. Eight patients required more than one treatment session (range, 2-6). At follow-up after 6 months, 10 of 13 (77%) patients reported a substantial improvement in their symptoms and contact lens wear time.

Conclusions: Argon laser punctal stenosis provides a useful and titratable treatment for contact lens intolerance due to dry eyes.

Key Words: argon laser punctal, contact lens, dry eye

Introduction

According to recent market statistics, the United States may have as many as 38 million contact lens wearers among approximately 125 million wearers worldwide.¹ It has been estimated that 30% to 50% discontinue contact lens wear temporarily and at least half of them do so for 2 years or longer.² Contact lens-induced dryness has been cited as the most common reason leading to contact lens intolerance and subsequent discontinuation.²⁻⁴ According to a recent study, dry eye symptoms were reported in 78% of contact lens wearers and eye dryness was indicated as one of the most frequent ocular symptoms in contact lens wearers.⁵ Additionally, contact lens-induced dry eye has been associated with changes in functional visual acuity⁶⁻⁷ as well as increased risk of ocular surface desiccation, bacterial binding and infection.^{6,8-9} As the popularity of contact lens utilization continues to rise^{1,3}, dry eye symptoms will continue to pose a significant risk to patient care and satisfaction.

A comprehensive identification of the dry eye state is provided by Pflugfelder in which he defines it as the dysfunction of the lacrimal functional unit consisting of the ocular surface, main and accessory lacrimal glands, and the interconnecting neuronal innervations. This dysfunction causes an unstable tear film which in turn promotes ocular surface inflammation, epithelial disease, and symptoms of discomfort.¹⁰ This unit functions as a continuum; the interconnectedness of these individual players allow for varied causes of dry eye disease (aqueous deficiency, directly disrupting tear film, etc.) to set off a cascade of events that affect all aspects of the lacrimal functional unit and thus tear film composition and stability. Therefore, treatment modalities can be directed at any one of these components of the lacrimal functional unit and provide relief to all aspects of the entire unit. Contact lens wear is known to directly induce tear film instability and secondary dry eyes.¹¹⁻¹² Traditionally, treatments have been focused on enhancing volume of tears in order to overcome any aqueous deficiency as well as promote overall tear film stability. The use of artificial tears provides temporary relief for such patients.¹¹⁻¹² However, frequent application of drops can be both inconvenient and expensive. Punctal occlusion provides a mechanism to maintain the patient's own tears for a longer period, thus decreasing the need for supplemental drops. However, there is wide variability among patients and therefore total punctal occlusion (thermal cautery and

punctal plugs) may not be appropriate for every patient, given that in many cases their symptoms are primarily present during contact lens wear. Previous studies on the use of punctal occlusion in contact lens wearers have found mixed results with some studies showing a benefit while others showing no significant beneficial effect.¹³⁻¹⁶ This may be in part because of the heterogeneous patient populations, small sample sizes, and perhaps the all-or-none effect of total punctal occlusion. Therefore, we hypothesize that punctal stenosis may provide a more physiological form of treatment, while still maintaining some degree of flow through the punctum.

Argon laser punctal stenosis is a relatively new strategy in the treatment of dry eyes. Unlike its counterparts (thermal cautery and punctal plugs), argon laser punctal stenosis does not have to provide only total punctal occlusion, as it can be titrated to achieve the desired effect.¹⁷ To date, there have been no published studies regarding its efficacy in the treatment of contact lens-induced dry eye. Given the ability of argon laser to titrate the effect of punctal stenosis, the greater convenience and less cost as compared to artificial tears, and less invasive nature of the procedure relative to other methods of punctal occlusion, we hypothesize that argon laser punctal stenosis will be an effective and desirable treatment in patients with contact lens intolerance due to dry eyes.

Materials and Methods

A retrospective review of 13 consecutive patients who underwent argon laser punctal stenosis for contact lens intolerance due to dry eyes was performed. Twelve wore soft contact lenses and one patient wore Rigid Gas Permeable (RGP) lenses. All patients reported dryness and foreign body sensation with contact lens wear that was relieved with artificial tears. Three patients had previously tried collagen plugs. Two patients had an underlying diagnosis of lupus and one had a positive Fluorescent Antinuclear Antibody (FANA), a sensitive screening test used to detect autoimmune diseases such as lupus. All patients were generally asymptomatic when not wearing contact lenses and only occasionally required the use of artificial tears. The slit lamp examination and the fluorescein staining pattern of the ocular surface were likewise unremarkable in all cases

in the absence of contact lenses. Patients were carefully examined for other contributing factors such as blepharitis and giant papillary conjunctivitis. The mean Schirmer I test (without anesthesia) after contact lens removal at 5 minutes was 15.2 mm (3-35).

After obtaining informed consent, a drop of Alcaine was placed in each eye. A cotton tip soaked in 4% lidocaine was placed over the puncta for 1-2 minutes. A marking pen was applied to the punctal area to provide pigmentation for absorption of the laser energy. Argon blue or green was used starting with a power of 300 mW and spot size of 100 μ with 0.1 second duration. Initially, a concentric ring of burns was placed 1 mm from the puncta followed by progressively smaller rings of burns with final shots directly over the punctal area. It typically required 100 shots per puncta to achieve the desired effect (Table I). The patients were re-examined at 2-3 months and the procedure was repeated or applied to the other puncta if the desired clinical effect had not been achieved. At their last follow-up, or by follow-up phone call, the patients' were asked to grade their improvement from baseline on a self-reported scale (0-4) based on the increase in their contact lens tolerance and reduced need for artificial tears: 0 = no improvement, 1 = minimal (< 25%) improvement, 2 = moderate (25%-50%) improvement, 3 = significant (50-75%) improvement, 4 = symptoms nearly resolved (75%-100% improvement). The primary outcome measure was contact lens tolerance which was measured using the survey.

For statistical analysis, it was assumed that the treatment would not make the condition worse, therefore the one-sided hypothesis included the two possibilities of at least moderate improvement (scores of 2 or greater) or staying the same (scores of 0 and 1). A continuity-corrected sign test using equation 3.3 given by Lehmann was applied.¹⁸ This statistic, which was calculated as 1.664, is approximately distributed as a standard normal with a p-value of 0.048 (<0.05 Type I error) for a one-sided hypothesis.

This study was approved by an Institutional Review Board and informed consent was obtained from all patients participating in the study.

Results

A total of 77 argon laser procedures were performed in 25 eyes. The mean age was 31 years (21-53) and 11 (85%) were female. All patients tolerated the procedure well and reported minimal to no discomfort. In 19 eyes the treatment only involved the lower punctum, while in six eyes it involved both the upper and lower puncta. Eight patients required more than one treatment session (range, 2-6). Overall, 12 puncta were treated only once, 8 puncta were treated twice, and 13 puncta were treated three or more times to achieve the desired degree of stenosis. At follow up after six months, 10 of 13 patients reported a substantial improvement (score ≥ 2) in their symptoms and contact lens wear time (Table II). Two patients had no improvement and one patient had only minimal improvement. None of the patients developed epiphora.

Discussion

While the exact mechanism is still unclear, there have been many proposed mechanisms in regards to contact lens-induced dry eye. Theories have centered on two critical aspects: quantity of tears and quality of tear film.¹⁹ In patients with mild aqueous tear deficiency, the quantity of tears is of primary concern to address patients' symptoms. However, contact lens wear has been shown to induce tear film instability by causing abnormalities of the lipid, aqueous, mucin, tear base, and surface.¹¹⁻¹² This induced dry eye state is further evident by the increased tear osmolality and evaporation of tear film in contact lens wearers compared to age and sex matched controls.^{6, 20, 21} Other proposed factors include possible inflammatory effects of contact lenses^{6, 22-25} and dewetting related to lack of biocompatibility of the lens surface.^{6, 22, 26, 27} Thus, the combination of reduced quantity of tears and tear film stability provide a challenge to physicians in treating patients with contact lens-induced dry eye.

Patients typically complain of irritation and foreign body sensation while wearing their contact lenses.⁵ It is likely that many of these patients actually have an underlying mild or moderate aqueous tear deficiency which is exacerbated by contact lens wear. Therefore, the treatment of contact lens-induced dry eyes has been primarily focused on replacing the aqueous component. However, dry eye is a very complex condition and it is

critical to address other underlying issues contributing to dry eye such as meibomian gland dysfunction, blepharitis, or papillary conjunctivitis which can contribute to the dry eye state or to the patient's symptoms.²⁸ Likewise, the lens type, lens fit, and the schedule of lens wear are important factors to take into consideration when treating contact lens-induced dry eyes.^{6,29} In general, silicone hydrogel soft lenses^{30,31} with a low water content and high oxygen permeability (Dk)^{22,31-34} as well as RGP lenses with low wetting angle allowing for better wettability³⁵ are recommended for patients with dry eye symptoms.

There are treatment options that have shown to be beneficial in both contact lens-induced dry eye and non-contact lens dryness. Of course, artificial tears are the most direct method of improving eye dryness in patients. As mentioned previously, however, it becomes very tedious and inconvenient to continually apply expensive artificial tears for symptom relief. More recently in the medication realm, cyclosporine 0.05% ophthalmic emulsion has emerged as a potential treatment. One recent study evaluating contact lens-intolerant patients and the use of cyclosporine 0.05% showed significant improvement in dry eye symptoms, decrease use of rewetting drops, increased wearing time, and improvements in temporal bulbar conjunctival fluorescein staining as compared to patients using rewetting drops only.³⁶ While another more recent study showed no statistically significant difference in objective findings and subjective reporting of symptoms between contact lens wearers with dry eyes using cyclosporine 0.05% compared to a placebo group using rewetting drops.³⁷ Thus, it appears the efficacy and benefits of cyclosporine in patients with contact lens-induced dry eye are unclear.

Punctal occlusion has been widely used as a treatment of aqueous deficient dry eyes. There are three primary strategies available for punctal occlusion: cautery, laser, and punctal plugs.³⁸ Cautery, a relatively destructive procedure, provides the most permanent technique for closing the puncta. This method is most suitable for patients with moderate-to-severe aqueous deficiency where there is also minimal chance of developing epiphora. The patients in this study were generally asymptomatic while not wearing contact lenses; therefore, permanent occlusion with cautery would not be considered the first choice.

Punctal plugs have become increasingly popular as an alternative to cauterization. Punctal plugs have been shown to be effective in the treatment of aqueous deficient dry eyes and significantly decrease dependency on tear supplements.³⁹ Several studies have reported on the use of punctal plugs in contact lens wearers with good results. It has been reported that lacrimal drainage occlusion with silicone intracanalicular plugs significantly improved the symptoms of dryness, lens awareness, and blur in hydrogel lens wearers who have dry eye.¹³ More recently, however, one study has shown that while both placement of punctal plugs and a sham procedure significantly improved dry eye symptoms in contact lens wearers, there was no significant difference in improvement of symptoms between the group of patients receiving punctal plugs and the sham procedure group.¹⁴ Furthermore, although reversible, a number of patients cannot tolerate punctal plugs and over time, a significant number of the plugs fall out and need to be replaced.^{15-16, 40} Nonetheless, punctal plugs are a reasonable choice for patients with contact lens-induced dry eyes.

In this study, argon laser was used to achieve punctal stenosis in 13 consecutive patients with contact lens intolerance due to dry eyes. Overall, 77% of the patients reported a substantial improvement in their symptoms and their contact lens tolerance. In most of these patients the goal was not complete and permanent occlusion of the puncta, but rather partial occlusion (stenosis) to relieve their symptoms. This allows the retention of tears that are more physiologic for the ocular surface than compared to artificial tears.^{41, 42} For many patients, the goal may be to simply reduce their need for frequent artificial tears which can be prohibitive to their lifestyle or professional activities. This can be more appealing to patients; not only in regards to convenience (quick surgical procedure versus constant application of artificial tears) but also in addressing the issue of cost-effectiveness.

Clinically, after one laser treatment, recanalization occurs within several weeks. However, there is residual stenosis at the puncta or the proximal canaliculus. Repeated treatments appear to have an additive effect, thus achieving greater and greater degrees of stenosis. Based on our clinical observations, there is a cumulative clinical response that correlates with progressive scarring and stenosis of the puncta after each treatment. This provides the primary advantages of the argon laser; that is, treatment can be titrated

according to the patient's clinical response. Both cautery and plugs, typically provide an all-or-none effect, however recently, punctal plugs have been designed to allow partial flow through the center of the plug.

A previous study using the argon laser reported that 86% of the treated puncta remained open after one year.⁴³ That study appeared to use a slightly different technique since the authors did not describe using a marking pen to provide additional pigmentation in the punctal area in order to improve the laser uptake. Thus, in order to achieve the necessary uptake they used significantly higher powers (2.0 - 2.4 watts) compared to our study (0.3 – 0.5 watts). In addition, they treated each puncta only once. The patient's clinical response to treatment was not reported in that study and complete occlusion of the puncta was the only reported outcome.

One of the limitations of our study was the absence of controls. Since the condition is typically bilateral, it may be possible in the future to use one eye as the control.

Another limitation of the study was the subjective nature of our self reported grading schematic. There are several validated questionnaires that can be used to evaluate patients with dry eye. Traditionally, the McMonnies Index and Ocular Surface Disease Index (OSDI) have been proven to be valid and reliable instruments for measuring the severity of dry eye disease in both patient care and clinical trials.⁴⁴⁻⁴⁵ Even more appropriate for our study, the contact lens dry eye questionnaire (CLDEQ) focuses solely on contact lens wearers and is designed to assess the prevalence, frequency, diurnal severity, and intrusiveness of dry eye ocular surface symptoms.⁵ More recently, the CLDEQ has been shown to be a more accurate and efficient screening questionnaire as compared to the McMonnies Index in regards to evaluating patients with contact lens-induced dry eye.⁴⁶⁻⁴⁷ Therefore, future prospective studies can utilize screening tools like the CLDEQ to measure patients' responses more accurately and reliably.

Previous studies involving other known treatments for contact lens-induced dry eye have also utilized several objective measures to aid in the evaluation of patients' response to various treatments. Tear Break Up Time (TBUT) has been used widely as a reliable test to assess tear film stability in both the clinical setting as well as in many research trials.⁴⁸⁻⁵⁰ In patients with contact lens-induced dry eye, the TBUT on the contact

lens surface is about half of the same measure on the corneal surface.²⁸ Rose bengal or lissamine green staining has also been particularly useful in detecting early or mild dry eyes by analyzing the conjunctiva.^{48,51} Tear interferometry can be used to evaluate prelens tear film thickness, contact lens center thickness, and postlens tear film thickness.¹⁴ Reduced tear film thickness has been shown to be a significant factor in the presence of contact lens-induced dry eye.^{14,22} Additionally, prelens tear film (PLTF) thinning time, which is rapid in patients with dry eye, can be a significant factor associated with dry eye status.²² Further tear analysis through measuring tear volume (meniscus height and phenol red thread)⁴⁹ and tear osmolality⁵² can prove to be very helpful as well in evaluating patients with dry eye.⁵³ As mentioned previously, it is important to note the exact type of lens and lens care system utilized by patients. In our study, we did not record the exact soft lens type or lens care system, which should be included in further studies. In future studies, we hope to implement these additional objective parameters to supplement our results. It is important to note, however, a balanced combination of objective criteria and subjective patient reporting of symptoms are vital to assessing the overall effect of any treatment on a patient's condition.

Overall, it has been demonstrated that argon laser punctal stenosis is a safe and potentially useful treatment for contact lens-induced dry eyes. It can be performed readily under topical anesthesia with no significant discomfort. More importantly, it provides the ability to titrate the level of treatment. Future studies may be beneficial to evaluate its role in non-contact lens wearers with mild-to-moderate aqueous tear deficiency.

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Table I. Procedure for Argon Laser Punctal Occlusion

1. Topical proparacaine placed in the eye
2. 4% lidocaine on Q-tip applied to punctum for 1-2 minutes
3. Punctal area marked with marking pen
4. Argon blue/green: 300 mW, 100u, 0.1 seconds, 100 shots/punctum

Table II. Results of Argon Laser Punctal Occlusion for Contact Lens-Induced Dry Eye

Age/Sex	Eye	Schirmer I	Lids treated	Power ¹ /shots ²	Improvement ³	Comments
21/F	OD	30	Ux3, Lx3	150-300/98	3	
	OS	30	Ux3, Lx3			
27/F	OD	15	Lx2	200-300/101	3	
	OS	19	Lx2			
40/F	OD	15	Lx6	200-300/97	2	Blepharitis
	OS	14	Lx6			
25/F	OD	7	Lx1	300/75	0	
	OS	5	Lx1			
28/F	OD	14	Lx1	300/80	0	Lupus
	OS	16	Lx1			
31/F	OD	21	Lx3, Ux1	300/87	2	
	OS	24	Lx3, Ux1			
28/M	OD	3	Lx3	150-250/101	2	Thermal cautery L OU
	OS	8	Lx3			
41/F	OD	7	Lx5, Ux2	250-300/96	3	
	OS	6	Lx5, Ux2			
53/F	OD	35	Lx2	300/96	2	
	OS	25	Lx2			
24/M	OD	25	Lx2	300/75	1	Lupus
	OS	23	Lx2			
24/F	OD	9	Lx1, Ux1	300/88	2	+ FANA
	OS	10	Lx1, Ux1			
36/F	OD	13	Lx1	250-300/99	2	
	OS	14	Lx1			
25/F	OD	10	Lx3	250/97	3	

L=Lower Punctum, U=Upper Punctum, M=Male, F=Female, OD=Right Eye, OS=Left Eye,
OU= Both Eyes

FANA=Fluorescent Antinuclear Antibody Test

x # = Number of treatment sessions per punctum

¹Power in milliwatts, ²Mean number of shots per treatment, ³Self reported improvement in contact lens wear tolerance: 0 = None, 1 = minimal (less than 25%), 2 = moderate (25-50% improvement), 3 = significant (50-75%), 4 = symptoms nearly resolved (75-100%).