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Anterior Segment OCT-Based Assessment of Efficacy of Topical Cyclosporine in Edematous Punctal Stenosis

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Research Article

Keywords: Punctal stenosis, cyclosporin-A, anterior segment optical coherence tomography, medical treatment

Posted Date: March 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9128655/v1

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Additional Declarations: No competing interests reported.

Version of Record: A version of this preprint was published at International Ophthalmology on September 10th, 2026. See the published version at https://doi.org/10.1007/s10792-026-04253-x.

Abstract

Purpose

To evaluate the effect of topical cyclosporine-A treatment on edematous punctal stenosis (PS) using anterior segment optical coherence tomography (AS-OCT).

Methods

Patients with edematous PS who suffered from epiphora for at least 3 months were prospectively evaluated. Those with history of acute/subacute infection, use of preservative-containing eyedrops or anti-glaucoma drops within 1 month, pathologies of other parts of nasolacrimal drainage system were excluded. All cases were treated with a regimen of two-week course of steroid drops and long-term preservative free cyclosporine-A drops. Munk score, outer punctal diameter (OPD), vertical canalicular length (VCL), inner punctal diameter (IPD) at 100 and 500μ, tear well diameter (TWD), tear well depth (TWDp) and punctal reserve (PR) on punctum-OCT were measured. Evaluations were performed at baseline, 1 month and 3 months post-treatment.

Results

Forty-four eyes of 22 patients were evaluated. Mean duration of symptoms was 7.4 ± 6.5 (3–24) months. Median Munk score was 4 (range 2–5) at the baseline, 0 (range, 0–5) at 1 month, and 1 (range, 0–3) at 3 months. Mean OPD at the 3rd month was significantly higher than the baseline (430.0 ± 115.5μ vs 491.4 ± 110.0μ, ANOVA p = 0.021). Other AS-OCT parameters did not show any significant change. One patient with no improvement in symptoms and findings with clinical treatment and underwent perforated punctal plug insertion.

Conclusion

Anti-inflammatory effect of topical Cyclosporine-A may be effective in managing long-lasting edematous PS by increasing the diameter of punctal opening and decreasing hyperlacrimation.

Introduction

Punctal stenosis (PS) is the narrowing of punctum, the most proximal part of nasolacrimal drainage system. It is estimated to effect 53-63.3% of individuals over 65 years old and 8%-37.8% of epiphora patients [1]. Chronic blepharitis, ectropion, antiglaucoma eye drops, preservative toxicity, systemic immunologic diseases, and chemotherapy are among reported risk factors. It can be classified according to shape of punctal orifice as membranous, slit-like, horseshoe, and pinpoint, or according to clinical appearance as edematous, stenotic, obliterated, and fibrous type. Edematous PS, also named as

inflammatory PS, punctal congestion syndrome or functional PS is characterized with hyperemia and edema of puntcal opening and congestion of punctum lumen and can be accompanied with canalicular inflammation and edema [2]. It can occur in cases of post-infection, acute or chronic topical drug toxicity, chronic blepharitis, ocular rosacea, conjunctivitis, or can be idiopathic. Cessation of offending agent and treating the underlying cause of inflammation is an effective treatment in cases with an identified underlying cause. For idiopathic cases, medical treatment with various topical or systemic antibiotics and anti-inflammatory agents as well as perforated punctal plugs (PPP) have been reported [3–7]. The purpose of this study is to evaluate symptomatic and anatomic effect of combined topical steroid and cyclosporine-A treatment on cases of long-term edematous PS using anterior segment optical coherence tomography (AS-OCT).

Methods

This prospective study was conducted at the oculoplastic clinic of a tertiary eye hospital. The study was approved by the Institutional Ethics Committee and conducted in accordance with the principles outlined in the Declaration of Helsinki (Approval number: E-24-352). Written informed consent was obtained from all participants included in the study. “Human research participants provided informed consent for publication of the images in Figs. 1, 2, and 3.

Patients experiencing epiphora for at least three months and diagnosed with edematous PS upon examination were included in the study. Edematous punctal stenosis was defined as stage 1 or 2 stenosis based on the Kashkouli grading system [8], accompanied by edematous punctal margins confirmed by slit-lamp biomicroscopy (Fig. 1). Exclusion criteria were as follows: a history of acute or subacute ocular infection, use of preservative-containing eye drops within the past month, stenosis involving other segments of the nasolacrimal drainage system, history of lacrimal surgery or trauma, and the presence of lower eyelid anomalies such as entropion, ectropion, trichiasis, or eyelid laxity.

A detailed medical history was obtained, and comprehensive ophthalmologic examination was performed on all participants. Nasolacrimal system evaluation included slit-lamp examination of the punctum and eyelid margins, as well as punctum dilatation and nasolacrimal irrigation in all cases. Following the diagnosis of edematous PS, all patients were prescribed topical loteprednol etabonate (three times daily) for two weeks and preservative-free topical cyclosporine-A (twice daily) and preservative free artificial tears for a total duration of three months. Epiphora severity was assessed using the Munk score [9], which ranges from 0 (no tearing) to 5 (constant tearing), based on how often the patient needs to wipe their tears. Munk scores were recorded at baseline and at the first and third months of treatment. Additionally, the same experienced specialist (HB) performed anterior segment optical coherence tomography (AS-OCT) imaging of the punctum at each visit to evaluate structural changes in punctal morphology over time.

Image Acquisition of Punctum Using Anterior Segment Optical Coherence Tomography

Lacrimal punctum imaging was performed using a spectral-domain optical coherence tomography device (Spectralis HRA + OCT, Heidelberg Engineering, Heidelberg, Germany) under standardized ambient lighting and room conditions. To minimize potential morphological changes induced by irrigation, AS-OCT imaging was conducted before nasolacrimal irrigation. The device settings were adjusted to activate both the “scleral scan” and “enhanced depth imaging (EDI)” modes, which optimize tissue penetration and allow for detailed visualization of deeper punctal structures [10]. A single horizontal cross-sectional scan was obtained per image.

For optimal visualization of the punctum, the lower eyelid was gently everted using a cotton-tipped applicator, taking care to avoid excessive traction or pressure. In each patient, at least three high-resolution, horizontal cross-sectional AS-OCT images were acquired. The highest-quality image was selected for analysis. All measurements were performed manually with the caliper tool in the device software by a single experienced grader (KY) who was masked to the clinical data.

The punctal parameters analyzed included the following, based on AS-OCT images obtained at baseline and at one and three months after treatment: Outer Punctal Diameter (OPD): distance between the two highest points of the punctal papilla at the external punctal opening; Internal Punctal Diameter at 100 μm (IPD-100): horizontal width of the canalicular lumen measured 100 μm below the external punctal surface; Internal Punctal Diameter at 500 μm (IPD-500): canalicular width measured 500 μm below the external surface; Punctal Depth (PD): vertical distance from the OPD tangent line to the deepest visible point of the punctum lumen; Tear Well Diameter (TWD): horizontal length of the tear meniscus within the punctum; Tear Well Depth (TWDp): vertical distance from the tear meniscus surface to the deepest point of the punctum; Punctal Reserve (PR): difference between punctal depth and tear well depth (PDS–TWDp), representing the potential space for tear accumulation (Fig. 2) [10–11].

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were reported as frequencies and percentages for categorical variables, and mean±standard deviation (SD) for continuous variables. The normality of data distribution was assessed using the Shapiro-Wilk test. Repeated-measures ANOVA was applied to compare punctum measurements from AS-OCT at baseline, the first month, and the third month post-treatment. When the overall ANOVA model was significant, Bonferroni post hoc tests were conducted for pairwise comparisons between means that were found to be significantly different. For Munk scores before and after treatment, the Friedman test was performed, followed by Wilcoxon signed-rank tests with Bonferroni correction for post hoc pairwise comparisons. To evaluate the relationship between AS-OCT parameters of the punctum and Munk scores, either Pearson or Spearman correlation analyses were performed, depending on the distribution of the data. To assess intraobserver reliability, 30% of the images were randomly chosen and remeasured by the same blinded examiner after a two-week interval. The intraclass correlation coefficient (ICC) was calculated for each parameter, with values greater than 0.75 indicating good reliability. A p-value < 0.05 was considered statistically significant.

Results

A total of 44 eyes from 22 patients were included in the study. Of these patients, 13 (59.1%) were female and 9 (40.9%) were male. Mean age was 59.2 ± 10.3 years (range, 44–80). Mean duration of epiphora symptoms was 7.4 ± 6.5 months (range, 3–24). Patients' Munk scores demonstrated a consistent and statistically significant decrease over time with treatment ($p < 0.001$). The median Munk score was 4 (range, 2–5) at baseline, 0 (range, 0–5) at one month, and 1.0 (range, 0–3) at three months after treatment. At the end of follow-up 85.3% eyes had Munk score less than 2. All pairwise comparisons between time points revealed statistically significant reductions (all $p < 0.001$) (Fig. 3).

Table 1 presents AS-OCT parameters of the punctum, including OPD, IPD-100, IPD-500, PD, TWD, TWDp, PR before treatment, as well as during the first month and third months of treatment. OPD measurements demonstrated a significant change over time ($p = 0.028$) (Fig. 4). The mean OPD at the third month was significantly higher compared to baseline ($p = 0.021$). No significant difference was found between baseline and the first month ($p = 1.000$). Although an increase was observed from the first to the third month, this difference did not reach statistical significance ($p = 0.053$). Other AS-OCT parameters, including IPD-100, IPD-500, PD, TWD, TWDp, and PR, did not exhibit significant change between baseline and post-treatment measurements ($p > 0.05$ for all). Pearson correlation analysis was performed between OPD, the only parameter that showed significant change over time, and the Munk score. No significant correlation was found between these variables ($p > 0.05$). Through follow-up 2 eyes of one patient whose symptoms and clinical findings did not improve with medical treatment underwent insertion of PPP.

Table 1
Comparison of AS-OCT parameters of the punctum at baseline, one month, and three months after treatment.

AS-OCT parameters of the punctum	**Pre-treatment mean ± SD (range)**	**First month of treatment mean ± SD (range)**	**Third month of treatment mean ± SD (range)**	**ICC**	***P- value***
Outer punctum diameter (µm)	430.0 ± 115.5 (198–689)	442.0 ± 116.8 (216–767)	491.4 ± 110.0 (282–700)	*0.95*	**0.028**[¥], 1.000[a], 0**.021**[b], 0.053[c]
Internal punctum diameter at 100 µm (µm)	136.1 ± 75.3 (44–434)	139.5 ± 70.4 (42–367)	138.6 ± 69.6 (56–355)	*0.89*	0.725[¥]
Internal punctum diameter at 500 µm (µm)	39.0 ± 20.4 (10–113)	45.3 ± 22.5 (17–117)	41.8 ± 19.8 (13–94)	*0.78*	0.273[¥]
Punctum depth (µm)	1276.2 ± 189.6 (141–1657)	1254.2 ± 92.7 (526–1635)	1378.1 ± 138.2 (1043–1714)	0.93	0.245[¥]
Tear well diameter (µm)	145.0 ± 51.8 (75–284)	158.4 ± 75.0 (57–600)	227.0 ± 89.9 (80–448)	0.91	0.069[¥]
Tear well depth (µm)	1186.5 ± 130.0 (107–1606)	1245.9 ± 231.1 (453–1563)	1249.0 ± 127.4 (1004–1639)	0.88	0.152[¥]

AS-OCT: Anterior segment optical coherence tomography, ICC: intraclass correlation coefficient

[¥]Repeated measure of ANOVA (comparison among three groups)

[a] Significance between Pre-treatment and the First month of treatment (pairwise comparison)

[b] Significance between Pre-treatment and the Third month of treatment (pairwise comparison)

[c] Significance between the First month of treatment and the Third month of treatment (pairwise comparison)

Bold values indicate statistically significant values.

AS-OCT parameters of the punctum	Pre-treatment mean ± SD (range)	First month of treatment mean ± SD (range)	Third month of treatment mean ± SD (range)	ICC	*P- value*
Punctal Reserve (μm)	94.0 ± 24.0 (34–271)	107.5 ± 48.1 (10–199)	92.2 ± 16.9 (22–202)	0.81	0.615¥
AS-OCT: Anterior segment optical coherence tomography, ICC: intraclass correlation coefficient					
¥Repeated measure of ANOVA (comparison among three groups)					
[a] Significance between Pre-treatment and the First month of treatment (pairwise comparison)					
[b] Significance between Pre-treatment and the Third month of treatment (pairwise comparison)					
[c] Significance between the First month of treatment and the Third month of treatment (pairwise comparison)					
Bold values indicate statistically significant values.					

Discussion

Idiopathic edematous PS is a complex disease that is often complicated with repetitive use of topical drops with potentially toxic preservatives and mechanical trauma to mucosa due to repetitive dilatation and syringing [12]. Chronic inflammation and subsequent fibrosis were reported in histopathological studies of PS patients [13]. A bidirectional relationship between ocular surface diseases and acquired PS was established in a study where 35% PS patients had ocular surface disease symptoms [14]. Furthermore, delay in tear clearance was associated with ocular surface inflammation [15]. Various types of anti-inflammatory agents has been described for treatment of edematous PS. In 2018 Kornhauser et al. reported that majority of cases of inflammatory edematous PS cases were females with a mean age of 35 years. They used a variety of anti-inflammatory treatment including topical steroids, tacrolimus ointment, or matrix metalloproteinase inhibitors and reported symptomatic and anatomic success in 62.5% of the cases [3]. Elshobargy et al. [16] reported significant symptomatic improvement supported by anatomical improvement observed via AS-OCT following one month of preservative free methylprednisolone drops. Elalfy et al. [6] compared preservative free corticosteroid drops and artificial tear combination to artificial tears alone in edematous PS patients with maximum 3 months of epiphora symptoms. They monitored punctal diameter using AS-OCT and found significant symptomatic and anatomic improvement in both groups at the end of 3 months with higher patient satisfaction in corticosteroid group.

However, partial or refractory disease with corticosteroid treatment has also been reported, especially in cases with longer duration of symptoms [3]. Bian et al proposed that intermittent use of corticosteroid or

combination steroid-antibiotic drops could in fact be harmful in long-term treatment of epiphora patients with edematous PS. They hypothesized that most of the time epiphora starts with an inciting event and while these agents provide initial symptomatic relief, toxic effects of active ingredients or preservatives and mechanical damage caused by repetitive dilation/probing could outlast beneficial effects and patients may have recurring symptoms of epiphora. This cycle leads to unsatisfied patients with chronic epiphora and inflammatory edematous PS. They suggested cessation of all topical agents and reported that all patients' symptoms resolved in maximum of 7 months [12]. However, waiting for months without treatment may be difficult for some patients, and progressive cases that do not resolve spontaneously have been reported in other studies [2, 3].

Topical preservative free cyclosporine-A is a well-known anti-inflammatory agent that inhibits calcineurin. In the context of ocular surface inflammation, cyclosporine A helps restore tear film stability and reduce chronic inflammation by modulating T-cell–mediated immune activity on the conjunctiva and lacrimal glands. While it has been used successfully in topical preservative free drop form for dry eye syndrome and various ocular surface disorders for many years [17], its efficacy in epiphora related to stenosis of proximal nasolacrimal drainage apparatus has been a subject of more recent studies. Ali et al reported that using topical cyclosporine-A helped resolving inflammation in 70% of the cases in their series of progressive idiopathic canalicular inflammation that was unresponsive to topical steroids and Mini Monoka stent implantation [18]. In a study comparing topical cyclosporine-A drops to Mini Monoka stent intubation in PS patients; although stent intubation led to a better anatomic improvement in the early months, there was no significant difference between the groups in terms of punctum orifice size at the end of 6 months. Furthermore, Cyclosporine-A was associated with better symptomatic improvement [19].

In our study, majority of patients reported significant reduction in epiphora starting from first month, and 85% of the cases had a Munk score of less than 2 at the end of follow-up. AS-OCT revealed sustained increase in OPD over three months. One case that was not responsive to topical treatment required PPP insertion. We postulate that corticosteroid drops may have helped with initial rapid symptomatic relief, while longer term anti-inflammatory effect of cyclosporine-A may have contributed to the lasting anatomical changes observed with AS-OCT. Topical anti-inflammatory treatment was shown to be effective for treatment of epiphora with no known underlying cause possibly due to decreasing hyperlacrimation [20], and this effect may have contributed to the dramatic decrease of epiphora observed in this study.

The cases in our series had epiphora ranging between 3–24 months. While discontinuation of toxic medications and use of preservative-free artificial tear drops may be sufficient for patients with acute symptoms, this approach may not be enough for chronic epiphora cases with complex etiologies. Since PS was shown to be closely linked with OSD in one third of the cases [14], prolonged topical treatment with cyclosporine-A may be effective in treating cases of chronic epiphora due to edematous PS medically, decreasing the need for invasive surgical approaches which may led to complications such as canaliculitis or further nasolacrimal system obstruction [7]. Additionally, the symptomatic improvement

observed early in treatment may contribute to increased patient satisfaction and adherence, which are critical in the management of chronic ocular conditions.

Limitations of this study includes its relatively short follow-up period and small sample size, which may limit generalizability. Additionally, the absence of a control group receiving artificial tears alone or placebo restricts our ability to isolate the effect of cyclosporine-A. Furthermore, signs and symptoms of ocular surface disorders such as OSDI score and tear beak-up time which could provide objective data on change in ocular surface inflammation were not evaluated. Future randomized controlled trials with larger cohorts are necessary to draw conclusive results on its indications, optimal dosage, and treatment duration. Moreover, identifying the underlying etiology of inflammation in edematous PS patients may enable more targeted and effective medical treatment.

Conclusion

Our results suggest that combining short term topical corticosteroids with topical cyclosporin-A drops may be effective in managing chronic ocular surface inflammation, therefore both decreasing hyperlacrimation and increasing the diameter of punctal opening in edematous PS patients. Our findings highlight the potential clinical benefit of this approach in managing edematous punctal stenosis.

Declarations

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript. The authors have no relevant financial or non-financial interests to disclose. All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was written by Hilal Nalcı Baytaroğlu and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Author Contribution

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was written by Hilal Nalcı Baytaroğlu and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

References

1. Tawfik HA and Ali MJ. A major review of punctal stenosis: Updated anatomy, epidemiology, etiology, and clinical presentation. *Surv Ophthalmol* 2024; 69: 441–455. 20240208. DOI: 10.1016/j.survophthal.2024.02.001.

2. Ali MJ. Idiopathic Canalicular Inflammatory Disease: New Disease Description of Clinical Patterns, Investigations, Management, and Outcomes. *Ophthalmic Plast Reconstr Surg* 2018; 34: 528–532. DOI: 10.1097/iop.0000000000001064.
3. Kornhauser T, Segal A, Walter E, et al. Idiopathic edematous punctal stenosis with chronic epiphora: preponderance in young women. *Int Ophthalmol* 2019; 39: 1981–1986. 20180929. DOI: 10.1007/s10792-018-1031-y.
4. Awny I, Mossa EAM, Bakheet TM, et al. Changes of Lacrimal Puncta by Anterior Segment Optical Coherence Tomography after Topical Combined Antibiotic and Steroid Treatment in Cases of Inflammatory Punctual Stenosis. *J Ophthalmol* 2022; 2022: 7988091. 20220124. DOI: 10.1155/2022/7988091.
5. Awny I, Mossa EAM, Bakheet TM, et al. Evaluation of Lacrimal Punctal Changes by Anterior Segment Optical Coherence Tomography after Punctal Dilation Versus Punctal Plug Insertion in Cases of Inflammatory Punctual Stenosis. *J Ophthalmol* 2022; 2022: 7666323. 20221020. DOI: 10.1155/2022/7666323.
6. Elalfy HY, Elsamkary MA, Elridy AMS, et al. Medical treatment of inflammatory punctual stenosis monitored by anterior segment optical coherence tomography. *Int J Ophthalmol* 2020; 13: 1074–1078. 20200718. DOI: 10.18240/ijo.2020.07.09.
7. Tawfik HA and Ali MJ. A major review on punctal stenosis: Part II: Updated therapeutic interventions, complications, and outcomes. *Surv Ophthalmol* 2024; 69: 756–768. 20240523. DOI: 10.1016/j.survophthal.2024.05.007.
8. Kashkouli MB, Nilforushan N, Nojomi N, et al. External lacrimal punctum grading: reliability and interobserver variation. *Eur J Ophthalmol* 2008; 18: 507–511. DOI: 10.1177/112067210801800401.
9. Munk PL, Lin DT and Morris DC. Epiphora: treatment by means of dacryocystoplasty with balloon dilation of the nasolacrimal drainage apparatus. *Radiology* 1990; 177: 687–690. DOI: 10.1148/radiology.177.3.2243969.
10. Sabermoghaddam A, Golestani S, Hassanpour K, et al. Investigation of the Lower Punctum Parameters: A Spectral Domain Anterior Segment Optical Coherence Tomography Study. *J Curr Ophthalmol* 2021; 33: 124–127. 20210705. DOI: 10.4103/joco.Joco_131_20.
11. Sung Y, Park JS and Lew H. Measurement of lacrimal punctum using spectralis domain anterior optical coherence tomography. *Acta Ophthalmol* 2017; 95: e619-e624. 20161228. DOI: 10.1111/aos.13322.
12. Bian Y, Scofield-Kaplan SM, Zemsky C, et al. Punctal Congestion Syndrome: A Reversible, Functional Punctal Stenosis Causing Epiphora in the Setting of Chronic Pretarsal Conjunctivitis. *Ophthalmic Plast Reconstr Surg* 2021; 37: S92-s97. DOI: 10.1097/iop.0000000000001840.
13. Ali MJ, Mishra DK, Baig F, et al. Punctal stenosis: histopathology, immunology, and electron microscopic features-a step toward unraveling the mysterious etiopathogenesis. *Ophthalmic Plast Reconstr Surg* 2015; 31: 98–102. DOI: 10.1097/iop.0000000000000204.

14. Barzelay YL, Carmon D, Dagan M, et al. Association Between Acquired Punctal Stenosis and Ocular Surface Disease: the Egg and the Chicken Story. *Semin Ophthalmol* 2024: 1–8. 20240426. DOI: 10.1080/08820538.2024.2345279.
15. Prabhasawat P and Tseng SC. Frequent association of delayed tear clearance in ocular irritation. *Br J Ophthalmol* 1998; 82: 666–675. DOI: 10.1136/bjo.82.6.666.
16. Elshorbagy MS, Shalaby OE, Eldesouky MA, et al. Anterior Segment Optical Coherence Tomography (AS-OCT) Guided Reversal of Edematous Punctal Occlusion. *Clin Ophthalmol* 2020; 14: 1467–1472. 20200527. DOI: 10.2147/opth.S255979.
17. Doctor MB, Kate A, Tallapelly HG, et al. The Role of Topical Cyclosporine A in Ocular Surface Inflammatory Disorders. *Semin Ophthalmol* 2025: 1–12. 20250604. DOI: 10.1080/08820538.2025.2512759.
18. Ali MJ and Bothra N. Update on Idiopathic Canalicular Inflammatory Disease (ICID): Outcomes With Addition of Topical Cyclosporine and the Modified Treatment Protocol. *Ophthalmic Plast Reconstr Surg* 2021; 37: 38–41. DOI: 10.1097/iop.0000000000001672.
19. Nassief M and Lotfy NM. Topical cyclosporin A 0.05% eye drops for management of symptomatic acquired punctal stenosis: a prospective, controlled clinical study. *Orbit* 2024; 43: 190–195. 20230718. DOI: 10.1080/01676830.2023.2232028.
20. Ceylanoglu KS and Sen EM. The effect of topical steroids and non-steroidal anti inflammatory drugs on epiphora of unknown cause: Optical coherence tomography study. *Photodiagnosis Photodyn Ther* 2023; 41: 103234. 20221205. DOI: 10.1016/j.pdpdt.2022.103234.

Figures

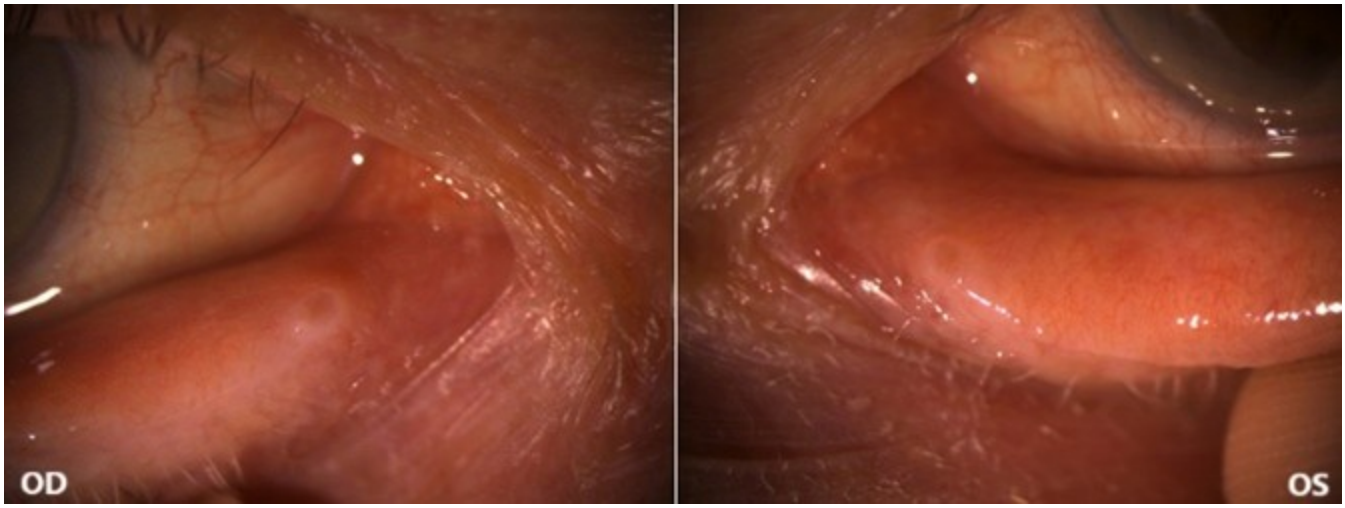


Figure 1

Anterior segment photographs of both eyes in a patient with bilateral edematous punctal stenosis. Note the hyperemia, swelling, and narrowing of the punctal orifices in both the right and left lower eyelids, consistent with punctal obstruction.

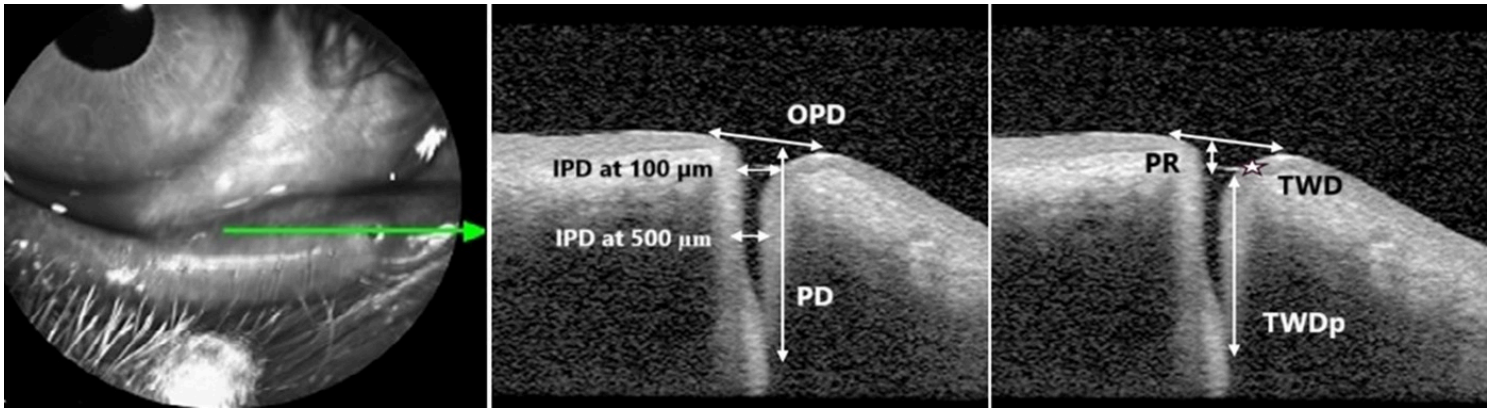


Figure 2

Anterior segment optical coherence tomography (AS-OCT) image of the punctum. Evaluated AS-OCT parameters are demonstrated, including outer punctal diameter (OPD), internal punctal diameter at 100 µm (IPD at 100 µm) and 500 µm (IPD at 500 µm), punctal depth (PD), tear well diameter (white star, TWD), tear well depth (TWDp), and punctal reserve (PR).

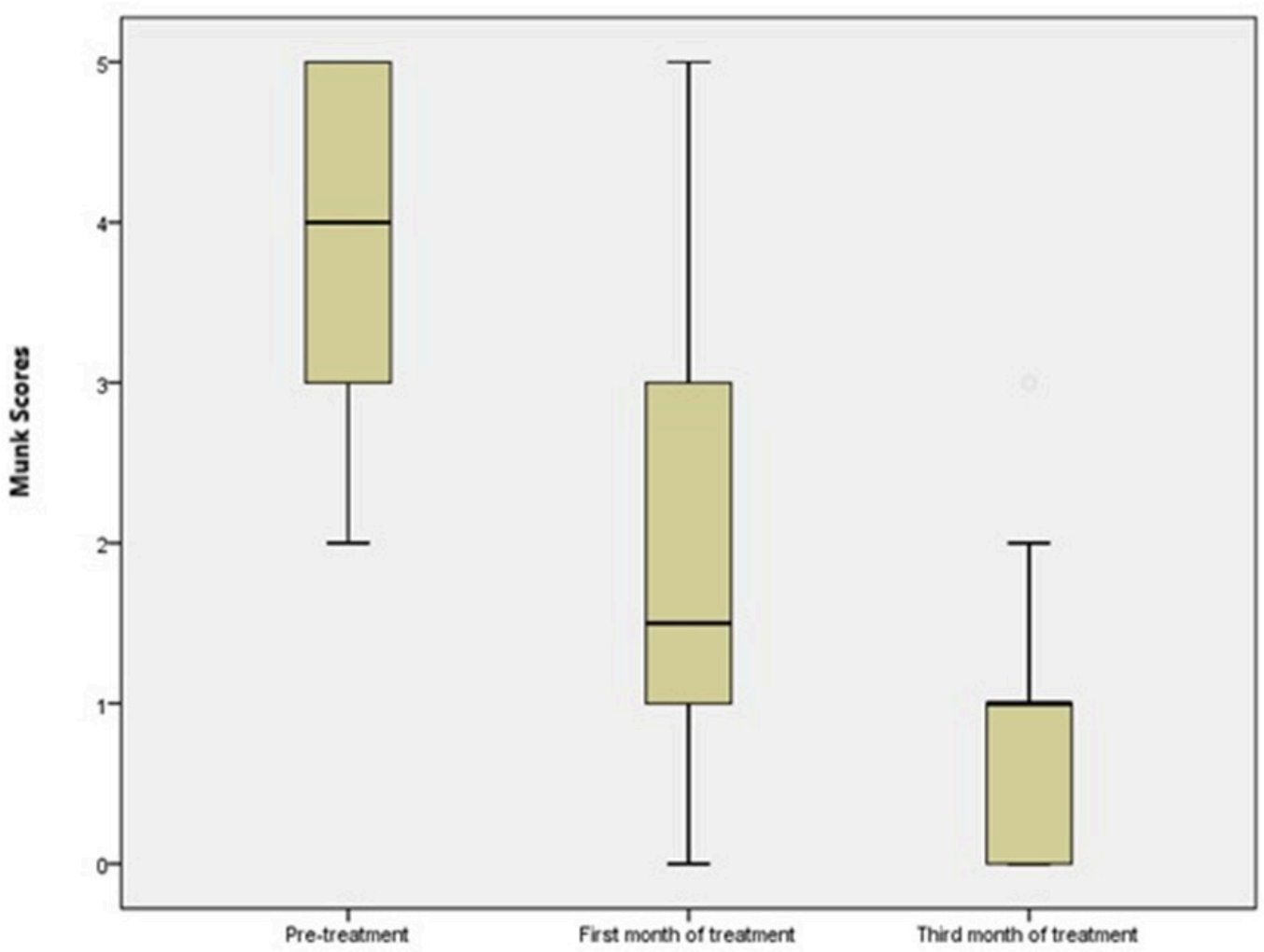


Figure 3

Boxplot illustrating the distribution of patients' Munk scores before treatment and at the first and third months after treatment.

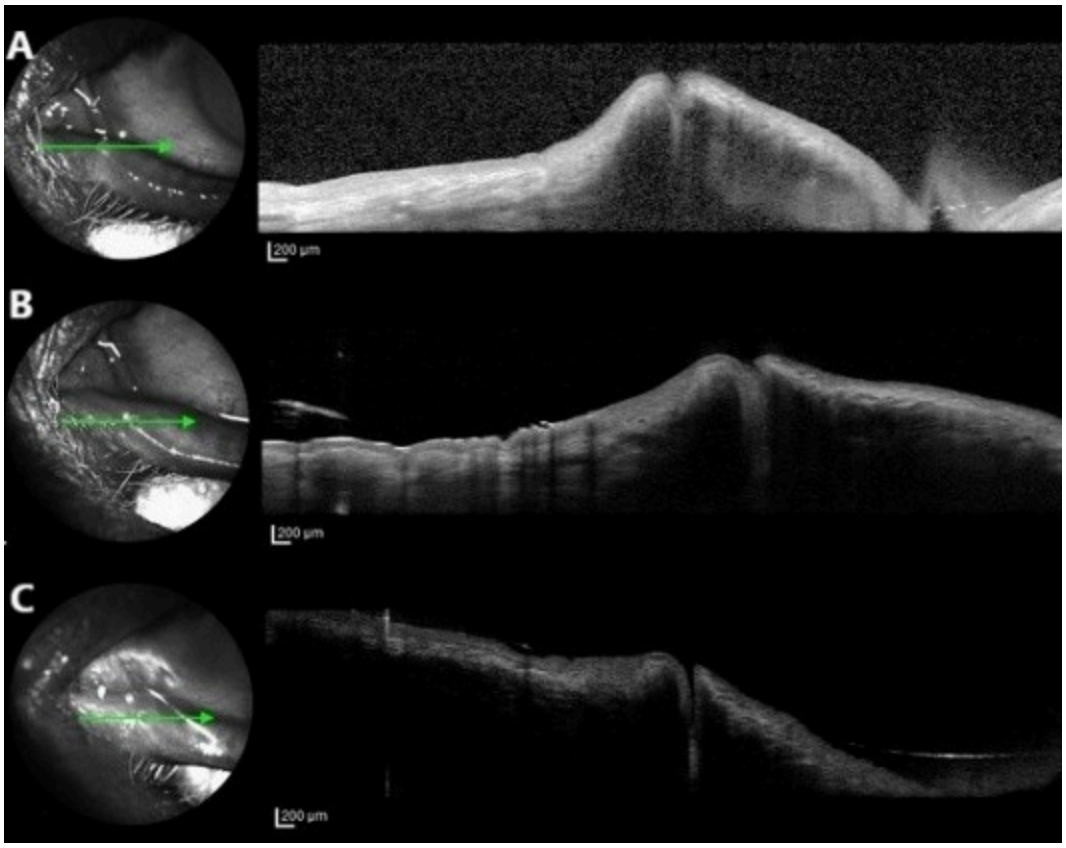


Figure 4

Anterior segment optical coherence tomography (AS-OCT) images of the punctum from a patient at baseline, and at the first and third months of treatment. (A) At presentation, the punctum appears edematous with a narrowed orifice, and the punctal lumen is not visible. The Munk score was 3. (B) At the first-month visit, although the punctum still appears edematous and narrow, the Munk score decreased to 0, possibly due to the effect of topical anti-inflammatory treatment. (C) At the third-month visit, a marked widening of the punctal orifice and a reduction in edema are observed on AS-OCT, and the Munk score remains 0.