International Medical Case Reports Journal

Dovepress
Taylor & Francis Group

Open Access Full Text Article

CASE REPORT

Combined Trans-Epithelial PRK and PTK for Treatment of Corneal Opacity Following Acanthamoeba Keratitis: A Case Report

Rosa Buonamassa[1], Giuseppe Addabbo[2], Francesco Pignatelli[2], Alfredo Niro[2], Fedele Passidomo[2]

[1]Eye Clinic, P.O. "Madonna delle Grazie", Matera, Italy; [2]Eye Clinic, "SS. Annunziata" Hospital, ASL Taranto, Taranto, Italy

Correspondence: Fedele Passidomo, Eye Clinic, "SS. Annunziata" Hospital, ASL Taranto, Via Francesco Bruno, 1, Taranto, 74121, Italy, Tel +3932885691 25, Email dotpaoli@yahoo.it

Purpose: To report a case of Corneal Opacity following Acanthamoeba Keratitis (AK) treated successfully with transepithelial customized Photorefractive Keratectomy (PRK) combined with Photorefractive Keratectomy (PRK).

Methods: One case report.

Results: A 27-year-old woman was referred to our clinic for Acanthamoeba keratitis in her left eye. After 1 year from the infection, the patient returned to our attention for developing a central corneal scar and decreased corrected distance visual acuity (CDVA) in the left eye. The slit-lamp examination showed a central corneal opacity involving anterior stroma. A single-step topography-guided trans-epithelial PRK combined with PTK (CIPTA®2 software, iVis Technologies) was performed in the left eye. After surface ablation using PRK, PTK was performed using masking agents (1% hydroxymethylcellulose) to smooth the ablated surface. Subsequently, 0.02% Mitomycin C was applied over the ablated surface. At the 1-month follow-up, a resolution of the corneal opacities was observed, with a visual improvement to 20/20, which was maintained at the 3-, 6-, and 12-months follow-up. Furthermore, there was an improvement in spherical equivalent and corneal morphological irregularity index.

Conclusion: Corneal opacity following AK may be successfully treated using a combined topography-guided trans-epithelial PRK and PTK in selected patients.

Keywords: Acanthamoeba keratitis, corneal degenerations, phototherapeutic keratectomy, topography-guided photorefractive keratectomy

Introduction

Acanthamoeba keratitis (AK) is a rare corneal infection that, if not diagnosed and treated properly, can be a sight-threatening disease.[1] The infection is caused by a unicellular protozoan of the genus Acanthamoeba that is universally widespread.

The global annual incidence of AK is estimated at approximately 23,561 cases, corresponding to a prevalence rate of about 2.9 cases per million individuals, accounting for roughly 2% of all corneal infections worldwide.[2]

The main known risk factors are contact lens (CL) wear, poor hygiene, swimming and showering with CL, inadequate CL disinfection, exposure to contaminated water, and corneal trauma.[3]

Even though the diagnosis can be challenging, an early recognition of AK is essential to ensure prompt treatment and good clinical outcomes.[4]

The mainstay of therapy is the use of topical agents such as biguanides as monotherapy (Polyhexamethylene biguanide (PHMB) 0.02% to 0.06% and chlorhexidine 0.02% to 0.2%) nor in combination with diamidines (0.1% propamidine isethionate, 0.15% dibromopropamidine, hexamidine 0.1% and neomycin). Antifungals such as Voriconazole or other azoles may be efficient as well.[5] Recently, a trial found that monotherapy with PHMB 0.08% was as effective as dual therapy with PHMB 0.02% and propamidine 0.1% with cure rates greater than 80%.[6]

Received: 26 September 2024
Accepted: 14 May 2025
Published: 28 May 2025

Unfortunately, the prognosis is often poor because of a significant delay in diagnosis and a lack of effective medical treatment. In more severe cases, the infection can lead to long-lasting stromal neovascularization, corneal opacity, and areas of corneal thinning.

In such cases, apart from medical therapy, several surgical approaches have been described: therapeutic perforating keratoplasty (PK), DALK, cryotherapy, phototherapeutic keratectomy (PTK), photo-activated chromophore for keratitis–corneal cross-linking (PACK-CXL).[7]

In cases where a corneal opacity develops after AK, there is an associated irregularity of the stromal surface at the site of the prior infection, which affects vision directly. In this scenario, Excimer laser PTK could be used to treat superficial corneal opacities and surface irregularities, avoiding the need for more invasive procedures such as optical lamellar or penetrating keratoplasty.[8]

In this paper, we report a case of corneal opacity following AK treated with excimer laser phototherapeutic keratectomy (PTK) and photorefractive keratectomy (PRK).

Case Description

A 27-year-old woman presented to our Ophthalmology Unit of "SS. Annunziata" Hospital, Taranto, with a 2-week history of left eye pain associated with blurred vision, photophobia and tearing.

Her past medical history was unremarkable, while her past ocular history was only significant for daily soft contact lens wear. The patient denied any previous ocular trauma but reported swimming with CLs in the previous days.

Upon examination, her visual acuity was hand-motion in the left eye (LE) and 20/20 in the right eye (RE). Slit-lamp examination revealed marked ciliary injection, corneal edema and a diffuse, gray, ring-shaped infiltrate with an overlaying epithelial defect. Her IOP was 10 mm Hg in the LE. The examination of the anterior chamber showed some cells, but the fundus examination was not possible.

Based on the clinical findings and on anamnestic information, the first diagnostic suspects were bacterial infection or Acanthamoeba infection. Corneal scrapings were taken for culture of fungi, bacteria and *Acanthamoeba*, and the patient was started on broad-spectrum topical antibiotic therapy. After 48 hours, the cultures came back positive for *Acanthamoeba spp*, the patient therapy was immediately changed to topical PMHB 0.02% every hour, atropine 1% 2 times a day and chlorhexidine 4 times a day. Over the next weeks, there was clinical improvement with resolution of the infection but persistence of a stromal corneal opacity.

After 1 year from the injection, the patient returned to our attention complaining of reduced vision. Her uncorrected distance visual acuity was 20/100, improving to 20/50 with a correction of sf+ 0.75 cyl −5.00 ax10°t. Slit-lamp examination revealed a rounded corneal opacity involving the visual axis, with no signs of infection (Figure 1). The

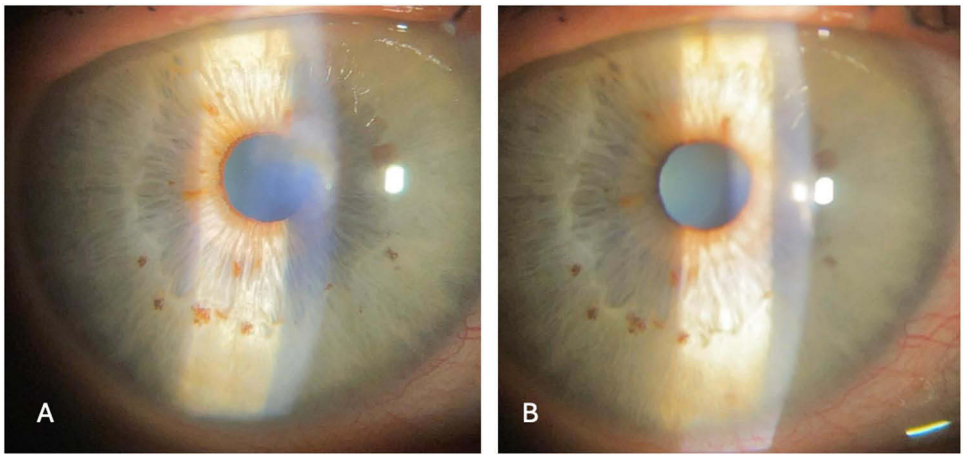

Figure 1 Slit-beam photography demonstrating central corneal opacity in the left eye before (**A**) and after (**B**) 3 months from combined excimer laser treatment, with corneal clarity being restored.

anterior segment optical coherence tomography (AS-OCT) showed a corneal scar in the anterior stroma of varying depth (from 50 µm to 133 µm), with irregular overlaying epithelium (Figure 2).

We planned a customized PTK with PRK to achieve the removal of the corneal scar along with a topographic regularization of the cornea.

The Institutional Review Board (IRB) of the Ophthalmology Unit of "SS. Annunziata" Hospital, Taranto approved the study protocol. All clinical procedures were conducted according to the principles of the Declaration of Helsinki. The patient provided informed consent for all procedures and their possible complications were explained. The patient gave informed consent for the publication of any case details and accompanying images. The IRB of the Ophthalmology Unit of "SS. Annunziata" Hospital, Taranto gave the approval for the publication of this case report.

We obtained the tomographic maps (Precisio2®, iVIS Technologies, Taranto, Italy) which showed in the left eye an irregular corneal morphology due to the presence of the opacity (Figure 3).

The customized plan was designed using the Corneal Interactive Programmed Topographic Ablation software 2 (CIPTA®, iVIS Technologies, Taranto, Italy).

The customized treatment was based on refractive and morphological data including spherical error collected by the visual acuity examination; biometric data including anterior chamber depth, axial length; corneal morphological irregularity index (CMI) measured by tomographer (Precisio2®, iVIS Technologies, Taranto, Italy); target refractive zone and ablation zone defined by the projection of an ideal pupil, identified by dynamic pupillometry (pMetrics®, iVIS Technologies, Taranto, Italy), onto the ideal corneal surface.

The customized ablation profile obtained had a refractive zone of 1.8 mm and a connecting zone of 7.5 mm. The cumulative ablation depth was 135 µm (Figure 4).

After surface ablation, PTK was performed using masking agents (1% hydroxymethylcellulose) to smooth the ablated surface. Subsequently, 0.02% Mitomycin C (MMC, 0.2 mg/mL, diluted in BSS®) was applied over the ablated surface for a duration of 20 seconds. At the end of the procedure, a soft therapeutic contact lens was placed.

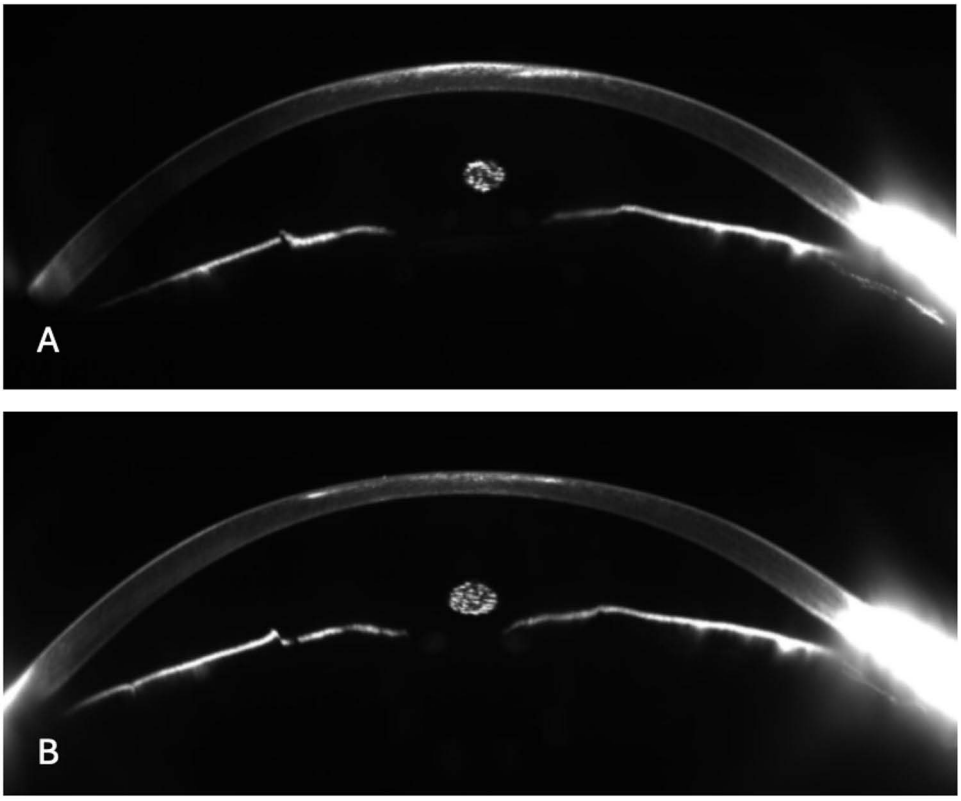

Figure 2 AS-OCT before (**A**) and after (**B**) the combined excimer laser treatment, showing the resolution of the hyperreflectivity.

https://doi.org/10.2147/IMCRJ.S495729

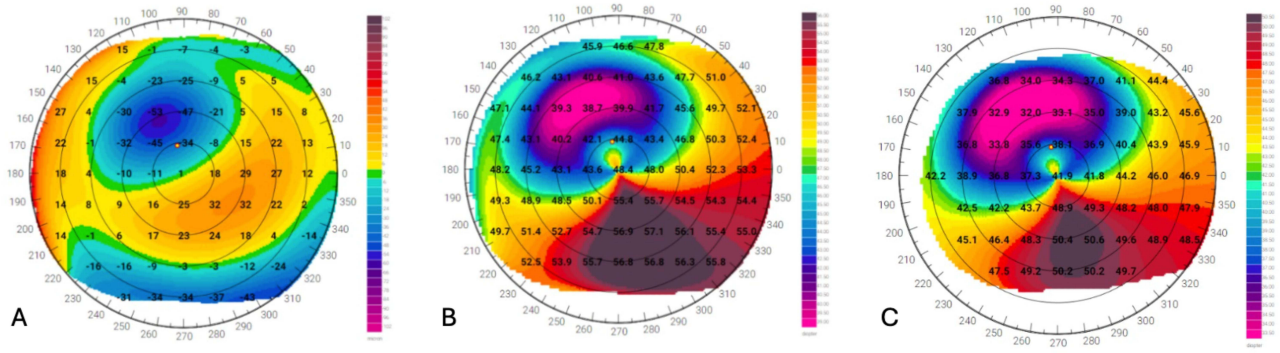

Figure 3 Preoperative tomographic maps of the left eye; (**A**) elevation anterior map, (**B**) anterior ray tracing map; (**C**) total corneal ray tracing map.

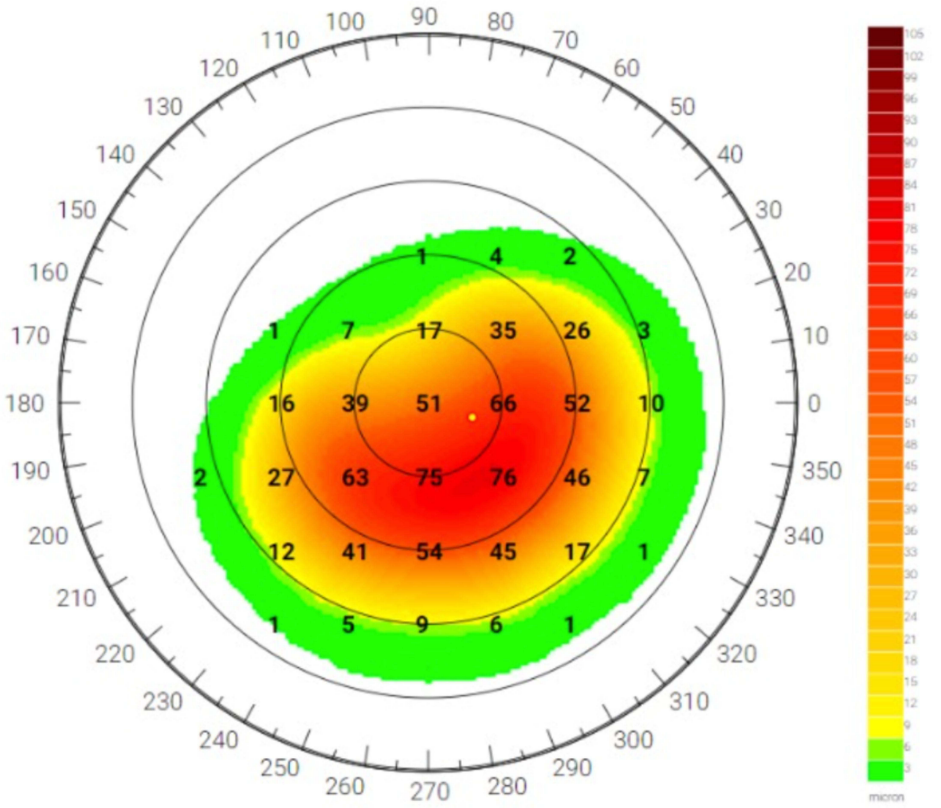

Figure 4 Ablation map of the left eye.

Postoperatively, topical dexamethasone and amikacin eye drops were administered four times daily for one week. The patient was then put on 0.1% fluorometholone eye drops and artificial tears eye drops for 12 weeks, which were gradually tapered afterward.

To avoid any recurrence of AK, the patient was put on prophylactic anti-amebic topical therapy with PHMB 0.02% 4 times a day 1 week prior the surgical intervention, which was then continued in the postoperative therapeutical regimen for 1 month.

The contact lens was removed after 1 week, with a complete epithelial healing. The UDVA was 20/20 with a correction of sf +0.75 cyl +3.00 ax 110 t. On slit-lamp examination the clarity of the ablated area was notably improved. The improvement of the visual acuity was maintained at the 1-month, 3-month and 6-month follow-up, with

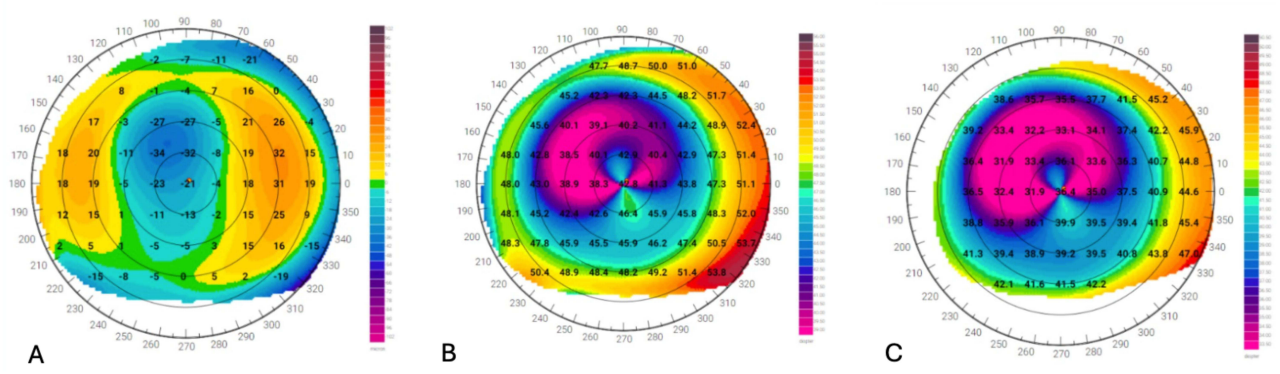

Figure 5 Postoperative tomographic maps of the left eye; (**A**) elevation anterior map, (**B**) anterior ray tracing map; (**C**) total corneal ray tracing map.

no evidence of recurrence of the Acanthamoeba infection. Figure 5 displays the postoperative tomographic maps showing a more regular corneal morphology with reduced CMI.

AS-OCT scans and topography were performed at 1 week, 1, 3 and 6 months after treatment.

Discussion

AK is a vision-threatening condition that can have devastating consequences, leading to poor visual outcome in 39% of affected eyes.[9]

Importantly, a prompt diagnosis reduces the risk of prolonged medical treatment and the need for surgical interventions. In fact, in cases of AK that are poorly responsive to medical treatment, surgical interventions, including therapeutical deep anterior lamellar keratoplasty (DALK) or therapeutical penetrating keratoplasty (PK), may be required. In a review, the rate of corneal transplantation required for AK was 16.68%, with the higher rate being performed between 8 and 16 weeks from the corneal infection.[10]

Once the infection has been treated, corneal scarring after AK results in significant visual impairment. Shimizu et al reported visual acuity after bacterial, fungal, herpetic, and acanthamoeba keratitis, showing that visual acuity deterioration was related to irregular astigmatism and high order aberrations.[11] In these cases in AK patients, optical keratoplasties (OKP) have showed better results than therapeutical keratoplasties in terms of visual prognosis and longer graft survival.[12]

PTK is a tool capable of addressing corneal opacity in approximately the anterior 100 to 150 μm of the corneal stroma. The use of excimer laser has already been proven to be a safe and effective technique in the treatment of corneal scarring from post infectious and post traumatic cases, thus reducing the need of a corneal transplant.[13,14] In addition, in many cases of corneal stromal opacity secondary to infectious keratitis, there is also an associated surface irregularity that must be treated and smoothened to obtain a more regular corneal morphology and thus a better visual outcome.[15] However, the excimer ablation of stromal opacities may induce an unpredictable degree of hyperopic shift.[16]

In this paper, we described the use of a Topography-Guided Trans-Epithelial PRK and PTK to treat corneal opacity following Acanthamoeba Keratitis, with good anatomical and functional results. We decided to perform a no-touch transepithelial approach, to minimize surgical invasiveness and to avoid the risk of stromal irregularities that manual epithelium removal could imply.

The use of a narrow optical zone along with a tissue sparing approach, thanks to the use of Ray Tracing guided algorithm, reduces the risk of hyperopic shift. Indeed, in our patient we did not observe postoperatively an important change in the spherical equivalent.

The use of PTK/PRK has been already described in literature for patients with visually significant corneal scarring secondary to Herpes Zoster Keratitis, particularly in the absence of active ocular surface disease and inflammation.

In literature, there are cases of AK resistant to medical anti amoebic therapy treated successfully with PTK, thanks to the direct removal of resistant amoebic cysts and better visual recovery without irregular astigmatism.[17] It is well known that the use of excimer laser can be a trigger for the reactivation of herpes simplex keratitis, placing the cornea at

potential risk for reactivation of other microbial infections. Even though there is no consensus about the use of preoperative anti-protozoal prophylaxis, we opted for a cautious use of PHMB.

Other authors have described the use of Photoactivated Chromophore for Infectious Keratitis Corneal Collagen Cross-Linking (PACK-CXL) as a viable therapeutic option in case of recalcitrant AK.[18]

To our knowledge, this is the first case described of Corneal Opacity secondary to AK successfully treated with a combined approach using a topography-guided trans-epithelial no-touch ablation with PRK and PTK.

Combining topography-guided trans-epithelial PRK and PTK could be a promising option for the treatment of corneal opacity secondary to infectious keratitis, improving corneal morphology and visual acuity and avoiding the need of corneal transplant. Careful patient selection along with a proper surgical planning can maximize the likelihood of achieving the best results. This procedure needs a longer follow-up and further study to evaluate its efficacy.

Funding

There is no funding to report.

Disclosure

The authors report no conflicts of interest in this work.

References

1. De Lacerda AG, Lira M. *Acanthamoeba* keratitis: a review of biology, pathophysiology and epidemiology. *Ophthalmic Physiol Opt*. 2021;41(1):116–135. doi:10.1111/opo.12752
2. Zhang Y, Xu X, Wei Z, Cao K, Zhang Z, Liang Q. The global epidemiology and clinical diagnosis of Acanthamoeba keratitis. *J Infect Public Health*. 2023;16(6):841–852. doi:10.1016/j.jiph.2023.03.020
3. Maycock NJR, Jayaswal R. Update on Acanthamoeba Keratitis: diagnosis, treatment, and outcomes. *Cornea*. 2016;35(5):713–720. doi:10.1097/ICO.0000000000000804
4. Lorenzo-Morales J, Khan NA, Walochnik J. An update on *Acanthamoeba* keratitis: diagnosis, pathogenesis and treatment. *Parasite*. 2015;22:10. doi:10.1051/parasite/2015010
5. Niro A, Pignatelli F, Fallico M, et al. Polyhexamethylene biguanide hydrochloride (PHMB)-properties and application of an antiseptic agent. A narrative review. *Eur J Ophthalmol*. 2023;33(2):655–666. doi:10.1177/11206721221124684
6. Dart JKG, Papa V, Rama P, et al. The orphan drug for Acanthamoeba Keratitis (ODAK) trial. *Ophthalmology*. 2024;131(3):277–287. doi:10.1016/j.ophtha.2023.09.031
7. Raghavan A, Rammohan R. Acanthamoeba keratitis – a review. *Indian J Ophthalmol*. 2024;72(4):473–482. doi:10.4103/IJO.IJO_2627_23
8. Campos M, Nielsen S, Szerenyi K, Garbus JJ, McDonnell PJ. Clinical follow-up of Phototherapeutic Keratectomy for treatment of corneal opacities. *Am J Ophthalmol*. 1993;115(4):433–440. doi:10.1016/S0002-9394(14)74443-5
9. Vilares-Morgado R, Ferreira AM, Marques-Couto P, et al. Clinical outcomes and prognostic factors in Acanthamoeba keratitis. *Contact Lens Anterior Eye*. 2024;47(2):102119. doi:10.1016/j.clae.2023.102119
10. Posarelli M, Passaro ML, Avolio FC, Costagliola C, Semeraro F, Romano V. The incidence of severe complications in acanthamoeba keratitis: qualitative and quantitative systematic assessment. *Surv Ophthalmol*. 2024;69(5):769–778. doi:10.1016/j.survophthal.2024.06.001
11. Shimizu E, Yamaguchi T, Yagi-Yaguchi Y, et al. Corneal higher-order aberrations in infectious keratitis. *Am J Ophthalmol*. 2017;175:148–158. doi:10.1016/j.ajo.2016.12.014
12. Di Zazzo A, Varacalli G, De Gregorio C, Coassin M, Bonini S. Therapeutic corneal transplantation in Acanthamoeba Keratitis: penetrating versus lamellar keratoplasty. *Cornea*. 2022;41(3):396–401. doi:10.1097/ICO.0000000000002880
13. Nagpal R, Maharana PK, Roop P, et al. Phototherapeutic keratectomy. *Surv Ophthalmol*. 2020;65(1):79–108. doi:10.1016/j.survophthal.2019.07.002
14. Sher NA. Clinical use of the 193-nm excimer laser in the treatment of corneal scars. *Arch Ophthalmol*. 1991;109(4):491. doi:10.1001/archopht.1991.01080040059027
15. Wilson SE, Marino GK, Medeiros CS, Santhiago MR. Phototherapeutic keratectomy: science and art. *J Refract Surg*. 2017;33(3):203–210. doi:10.3928/1081597X-20161123-01
16. Förster W, Atzler U, Ratkay I, Busse H. Therapeutic use of the 193-nm excimer laser in corneal pathologies. *Graefes Arch Clin Exp Ophthalmol*. 1997;235(5):296–305. doi:10.1007/BF01739639
17. Kandori M, Inoue T, Shimabukuro M, et al. Four cases of Acanthamoeba Keratitis treated with phototherapeutic keratectomy. *Cornea*. 2010;29(10):1199–1202. doi:10.1097/ICO.0b013e3181d3d674
18. Watson SH, Shekhawat NS, Daoud YJ. Treatment of recalcitrant Acanthamoeba Keratitis with photoactivated chromophore for infectious keratitis corneal collagen cross-linking (PACK-CXL). *Am J Ophthalmol Case Rep*. 2022;25:101330. doi:10.1016/j.ajoc.2022.101330