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Infectious keratitis: an update on the prevalence, risk factors, culture results, clinical features, visual outcomes, and therapeutic strategies of infectious keratitis

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Abstract. – OBJECTIVE: This study aimed to assess the prevalence, risk factors, culture results, clinical features, visual outcomes, and therapeutic strategies of infectious keratitis after surface ablation (PRK).

PATIENTS AND METHODS: This single-center prospective case-series review comprised 6500 eyes of 3400 patients undergoing PRK operation successively at the Ardabil Noor Surgical Center between January 1, 2003, and February 1, 2020. The incidence, risk factors, and clinical course were recorded for these samples.

RESULTS: Three clinical and culture-proven cases of infectious keratitis in three eyes of three patients were diagnosed during the study period. Post-operative keratitis was observed in cases 1 and 2 after 3 days and in case 3 after 112 days. The results of cultures were positive in all three cases. The isolated microorganisms were *Staphylococcus* species in cases 1 and 2 and *Candida Albicans* in case 3. The final corrected distance visual acuity was 20/25 and 20/20 in cases 1 and 2, respectively, and hand motion in case 3. All three patients had some risk factors such as well-controlled familial Mediterranean fever, mild Meibomian gland dysfunction, and the healthcare environment of the patient's wife in case 1, contact lens manipulation in case 2, and dry eye in case 3.

CONCLUSIONS: The prevalence of infectious keratitis after PRK was 0.046%. Infectious keratitis is one of the complications of PRK that can threaten patients' vision. Accordingly, proper preoperative clinical history taking, adequate eye exam and aggressive management can help maintain good eyesight in patients who undergo PRK surgery.

Key Words:
Infectious Keratitis, 6500 Photorefractive Keratectomy, *Staphylococcus, Candida Albicans.*

Introduction

Surface ablation procedures such as photorefractive keratectomy (PRK) are still the most prevalent laser kerato-refractive surgeries in many developing countries. The safety and efficacy of these techniques are well documented, and they have less initial or secondary flap complications (e.g., dry eye and corneal ectasia) compared to another techniques[1,2]. However, patients undergoing superficial ablation surgery require more time to recover and may develop infectious keratitis, which is a rare but serious and visual-threatening complication[1-5].

Some studies have evaluated the prevalence, risk factors, culture results, clinical features, visual outcomes, and therapeutic strategies of infectious keratitis caused by surface ablation procedures. Estimating the incidence of keratitis after PRK is challenging and highly dependent on the data source[1]. However, different studies have estimated an occurrence rate of 0.02-0.8 and 0-1.5% after PRK and LASIK, respectively[3-6]. Risk factors for post-PRK infectious keratitis include intraoperative contamination, excessive surgical manipulation, epithelial barrier breaks, a history of corneal surgery, delayed corneal re-epithelialization after surgery, application of topical steroids, and extended-wear bandage soft contact lens[7-9]. Infection after PRK is rare, and most related studies are retrospective. Single-center series by a single surgeon can report the occurrence under a controlled setting, in which both surgeons and patients observe identical protocols before, across, and after surgery. Due to the small number of patients, however, drawing up a reliable conclusion in this type of series is difficult. Different studies have reported different rates of infectious keratitis incidence after refractive surgery, thus more studies and case series presentations are necessary to further clarify the importance of this complication in patients undergoing refractive surgery[7,8].

In addition to reporting the incidence of infectious keratitis in a relatively large series (6500 eyes), we reported three cases of infectious kera-

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titis resulting from PRK with all procedures performed at the same surgery center by one surgeon. The cases were prospectively monitored to investigate the inception, etiology, risk factors, clinical course, and infection therapy of this complication to better understand its prevention, diagnosis, and management. To the best of our knowledge, this is the first case to present post-PRK infectious keratitis in a well-known familial Mediterranean fever (FMF) case.

Patients and Methods

This prospective case-series study included 6500 eyes of 3400 patients undergoing PRK surgery consecutively at the Ardabil Noor Surgical Center, a private practice setup, in Northwest Iran, between January 1, 2003, and February 1, 2020. All cases of infectious keratitis were followed up until February 1, 2021.

This study was performed in full accordance with the Declaration of Helsinki and written informed consent forms were collected from all patients. The inclusion criteria included having at least 18 years of age, normal corneal topography, and refractive stability for at least a year. On the other hand, the exclusion criteria were unstable refraction, corneal disease, diabetes, blepharitis, dry eyes, uncontrolled collagen vascular disease, glaucoma, and patients with topographic evidence of keratoconus. Infectious keratitis was diagnosed based on symptoms, culture results, microbiology, and slit-lamp findings. The criteria for clinical diagnosis included the symptoms of corneal infiltrates compatible with infectious keratitis without other noninfectious keratitis reasons. Cases with the onset of infectious keratitis three months and over after the surgical operation were identified as delayed infectious keratitis. Data regarding gender, age, infected eye, time from surgery, culture results, risk factors, post-op uncorrected distance visual acuity (UCDVA), pre- and post-op corrected distance visual acuity (CDVA), medical and surgical therapy, and complications were collected from the patient charts. To determine whether patients are suitable candidates, a complete ophthalmological examination was performed before surgery according to standard protocols. The surgical suite had the required criteria for performing ophthalmologic laser procedures, and standard protocols were observed throughout the procedures. The patients were asked for lid hygiene three days before the surgery, and all instruments were autoclaved for surgery. All PRK procedures were conducted by one corneal surgeon. Topical tetracaine 0.5% was administered into each eye before laser ablation. After applying alcohol 20% for 15 seconds, a standard epithelial defect within 8-9 mm in size was induced using a hockey spatula. Stromal ablation was completed by Allegretto Wave Eye-Q 400 (Wave Light Laser Technology AG, Erlangen, Germany). Laser ablation was performed on the right and left eyes, respectively. A therapeutic bandage soft contact lens (Air Optix, Aqua, Alcon Laboratories, Inc., Fort Worth, TX, USA; Material: Lotrafilcon B, 33% watered = 110) was fitted after the surgery.

Postoperative medications were identical in all patients. All subjects received topical betamethasone 0.1% six times per day across the first week after the surgery with a 5-week taper. In addition, Diclofenac sodium 0.1% was prescribed four times a day for two days, preservative-free artificial tears for three months, and chloramphenicol 0.1% until the healing of the epithelial defect. Postoperatively, the same surgeon examined all patients at one day, five days (to remove the contact lens), one month, three months, six months, and 12 months. However, more frequent visits were arranged in the cases of complications. The consequence measures included infectious keratitis occurrence after PRK, culture results, visual acuity, and response to treatment.

Results

In this study, 6500 PRK procedures were performed on 3400 patients. The mean age of the subjects was 29.35±6.95 years (range: 18-52 years) with a female to male ratio of 66.5%.

Definite culture-proven infectious keratitis was detected in three eyes of three patients with an overall rate of 0.046% per procedure. All infections were observed in the left eye. The mean follow-up was 56 months (range: 12-132 months). All patients attended visits, and none was lost to follow-up. However, the follow-up of one of the patients (case 3) was irregular due to the patient's poor cooperation and referral to another hospital.

The time from PRK to the onset of the initial symptoms was early in two eyes (three days for cases 1 and 2) and late in one eye (112 days for case 3). Data related to the three cases are summarized in Table I and are discussed in more detail below.

Table I. Summary of case infectious keratitis after PRK.

Patient	Day of presentation	Prophylactic treatment	Culture	Final UCVA	Final BCVA	Topical treatment
Case 1	3	Chloramphenicol	CPSA	20/100	20/25	V/Ce/Le
Case 2	3	Chloramphenicol	CNSA	20/20	20/20	V/Ce/Le
Case 3	112	Chloramphenicol	*Candida Albicans*	HM	HM	Am/Le/Vo

PRK: Photorefractive keratectomy, UCVA: uncorrected visual acuity, BCVA: best corrected visual acuity CPSA: coagulase positive staphylococcus aureus, CNSA: coagulase negative staphylococcus aureus, HM: hand motion, V: vancomycin, Ce: ceftazidim, Le: Levofoxacin, Vo: voriconazole.

Case 1

A 38-year-old male patient with right and left eye refraction of -1.25-0.50×110 and -1.50-0.50×50, respectively, underwent an uncomplicated bilateral PRK. Before the surgery, the patient was treated with a warm lid compress and azithromycin 250 mg daily for ten days due to extremely mild meibomian gland dysfunction. Preoperative best-corrected visual acuity (BSCVA) for each eye was 20/20. After PRK, he used topical Betamethasone 0.1%, Chloramphenicol 0.1%, and Artelac eye drop every four hours, as well as topical Diclofenac 0.1% every six hours, oral 500 mg effervescent vitamin C, and oral Ciprofloxacin 500 mg every 12 hours. On postoperative day three, the patient referred to the clinic with severe pain, purulent discharge, and conjunctival injection with significantly decreased VA on his left eye (hand motion at 10 cm). Slit-lamp examinations revealed a near-total (11 mm) corneal epithelial defect and a severe peripheral circular corneal stromal infiltration with a diameter of 11 mm and a width of 2.5 mm. A precise 0.5 mm clear interval between the infiltration and the limbus and a 2 mm Hypopyon were observed in the anterior chamber. The patient also had moderate Chemosis (Figure 1). Although the patient had no red reflex, his vitreous was clear on the B scan echography.

Despite taking an accurate clinical history, the patient hid his illness preoperatively. However, he expressed having a good-controlled FMF after involving in infectious keratitis. The patient's bandage contact lens (BCL) was removed, and he was hospitalized and stopped receiving topical diclofenac and betamethasone treatments. Topical chloramphenicol and oral ciprofloxacin were replaced by topical levofloxacin, fortified Vancomycin 50 mg/ml and Ceftazidime 50 mg/ml every half hour, and oral levofloxacin 500 mg every 12 hours. Topical Atropine 1% was used every six hours. Vancomycin 1 gr IV BID and Ceftazidime 1 gr IV BID were also prescribed for the patient due to the proximity of keratitis to the limbus. To inhibit the production of collagenase, oral doxycycline was prescribed at a dose of 100 mg twice a day. Smear and culture demonstrated Coagulase positive *Staphylococcus aureus* (CPSA) sensitive to Vancomycin, Ofloxacin, Levofloxacin, Tobramycin, and Azithromycin.

On postoperative day four, hypopyon disappeared, but infiltration was the same. VA was the counting finger (FC) at 0.5 meters.

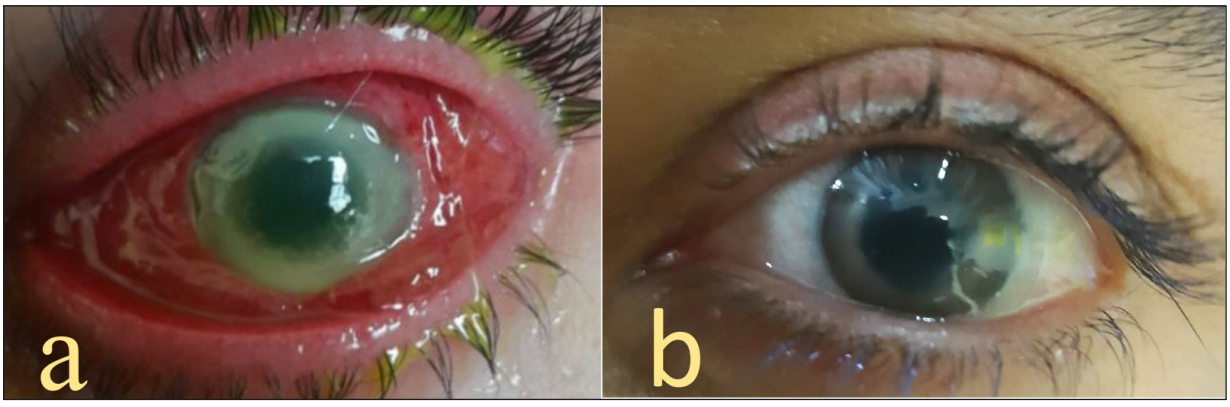

Figure 1. The case 1. (**a**) Four days after PRK and (**b**) two months after PRK.

On postoperative days five, six, and seven, VA was FC at 1, 2, and 2.5 meters, respectively. The epithelial defect reached 8 mm, and the density of stromal infiltration decreased on the seventh day. IV Ceftazidime was stopped on postoperative day five.

On postoperative day eight, Atropine 1% QID was substituted by Mydrax (Tropicamide 1%) TDS. Intravenous Vancomycin was stopped, and topical Betamethasone was used every eight hours. The patient was discharged from the hospital with the abovementioned order.

Conjunctival injection and stromal infiltration were significantly reduced on postoperative day 20, and the corneal epithelial defect reached 1.5 mm. UCDVA was FC at 5 meters.

The eye was white without conjunctival injection and corneal defect on postoperative day 30, and UCDVA was 20/200.

On postoperative day 60, only mild central corneal haziness with approximately 30% stromal thinning was observed on slit-lamp examinations. UCDVA was 20/100, and BCDVA was 20/25; however, a full auto-refractometer recorded the refraction of +4.00-4.50×180, and the patient had blurred vision. Slit-lamp examinations and visual acuity did not change 12 and 24 months postoperatively.

Case 2

A 26-year-old male patient underwent un-eventful PRK for myopia and astigmatism (OD: -4.25-1.00×40) and myopia (OS: -1.25 Sphere). Preoperative BSCVA was 20/20 for each eye. After PRK, he used Betamethasone, Chloramphenicol, and Artelac eye drop every four hours, and topical diclofenac every six hours, as well as oral effervescent tablet vitamin C 500 mg and oral ciprofloxacin 500 mg every 12 hours. On postoperative day three, the patient returned to the clinic with severe pain, purulent discharge, conjunctival injection with significantly decreased VA on his left eye and slit-lamp examinations represented an 8-mm corneal epithelial defect, a 6-mm central corneal stromal infiltration, and a 2-mm hypopyon (Figure 2). VA was hand motion at 10 cm. The patient had BCL manipulation the day before the visit. The smear and culture revealed coagulase-negative *S. aureus* (CNSA) that was sensitive to Vancomycin, Levofloxacin, Ofloxacin, Tobramycin, and Azithromycin. The patient's BCL was removed, and he was hospitalized. The patient stopped receiving topical Betamethasone and Diclofenac treatments. Topical Chloramphenicol and oral Ciprofloxacin were replaced by Levofloxacin fortified Vancomycin, and Ceftazidime eye drop every half hour and oral Levofloxacin every 12 hours. Atropin 1% was used every six hours.

On postoperative day four, the hypopyon became smaller (1.7 mm), and the infiltration demonstrated a decrease. VA was FC at 0.5 meter. On day six, the hypopyon completely disappeared, the stromal infiltration and the corneal epithelial defect size decreased, and UCDVA was FC at 2 meters (Figure 2).

On day 10, the stromal infiltration density was much less, and UCDVA was FC at 5 meters. The patient was discharged from the hospital and started on oral vitamin C and Levofloxacin every 12 hours, fortified Vancomycin with Levofloxacin every two hours, and Artelac eye drop every four hours. Afterward, Atropin eye drop was discarded, and topical Betamethasone was used every six hours to diminish cicatrization.

There was no conjunctival injection on day 25. The corneal epithelial defect was healed, and the corneal infiltration diminished progressively, with a VA of 20/200.

On postoperative day 75, the eye was completely white, and two mild vertical haziness (3 mm long and 1 mm wide) were observed in the cornea center. The cornea had a 25% thinning. UCDVA was 20/20, but the patient had blurred vision because of central haziness, and the full auto-refractometer repeatedly recorded the refraction of +4.00-3.50×10. Slit-lamp examinations and visual acuity showed no changes four and twelve months postoperatively.

Case 3

A 44-year-old female patient had uncomplicated PRK for myopia and astigmatism (OD: -6.50-1.75×154; OS: -6.75-0.50×35) with BSCVA of OD=20/25 and OS=20/30. Postoperative follow-up represented no problem within three months. On postoperative day 91, the patient referred to the clinic with a foreign body sensation and dry eye symptoms in her left eye. Fluorescein staining of the cornea revealed low break-up time (BUT, eight seconds) and diffused moderate punctate epithelial defects (PED) on her left eye. However, her right eye had no PED with BUT of 12 seconds. The patient started on Artelac eye drops every two hours and Liposic eye gel every night. Two weeks later, the patient visited the clinic with the same severity of PED. Thus, the frequency of Artelac and Liposic gel was increased to ev-

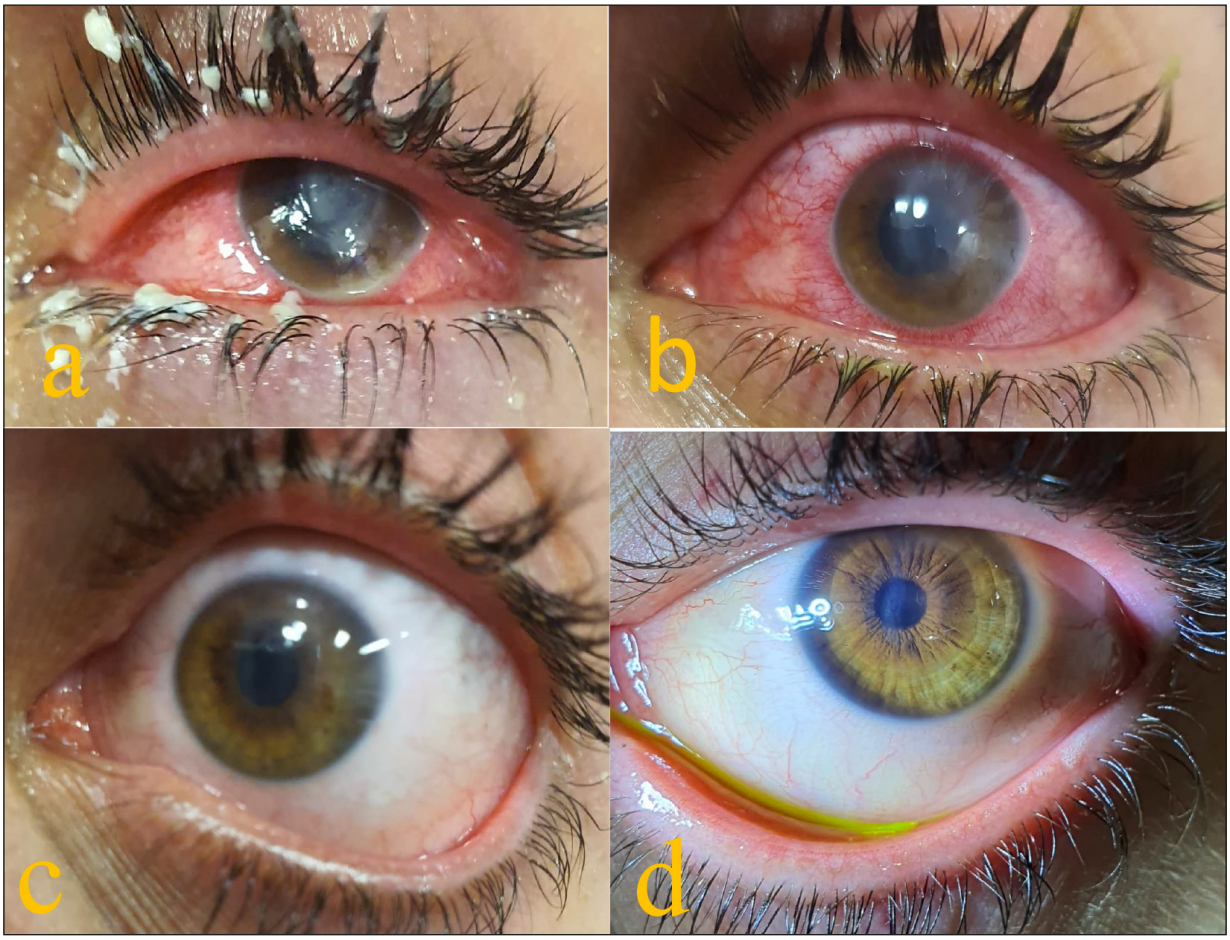

Figure 2. Case 2. (**a**) five days after PRK, (**b**) 10 days after PRK, (**c**) 75 days after PRK, (**d**) 160 days after PRK.

ery hour around the clock and every six hours, respectively. However, after a week of treatment, there was no improvement of dry eye. The cornea had multiple superficial white and raised colonies on slit-lamp examinations. Because of the appearance of keratitis and the gram stain, the patient was diagnosed with *Candida Albicans* (CA) and immediately received Amphotericin B 0.25% eye drops every half hour and Levofloxacin hourly. The patient was visited daily, but there was no improvement in the infiltration size and number.

CA diagnosis was confirmed 72 hours after the corneal culture. The Levofloxacin dosage was reduced to four times per day, but Amphotericin B was persisted every half hour. Further, oral Fluconazole 100 mg BID was added to the treatment. Due to the lack of response to the treatment within a week, the patient was referred to the Farabi Eye Hospital, a referral hospital in Tehran, Iran, for ophthalmic diseases, and despite the onset of topical Voriconazole 1% and the intrastromal injection of Voriconazole (100 mcg/0.1 ml), a therapeutic corneal graft was performed on the patient due to the progression of keratitis. Two months after PK, the patient's intraocular pressure (IOP) was 40 mm Hg. Thus, topical Co-Biosopt and Brimonidine were initiated for her. Due to the lack of response to IOP-lowering drops, shunt surgery was performed on the patient. Because of the failure of the first shunt surgery, the second shunt surgery was performed, and the patient's IOP was controlled with Co-Biosopt, Artelac, and Liposic Gel. However, both eyes had mild to moderate dry eye, and the IOP of OD was 33 mm Hg. Therefore, IOP lowering and dry eye treatment were also initiated on the right eye. After four years, the patient was under control, but corneal graft failure happened due to the corneal graft rejection. Thus, she underwent a re-graft surgery.

The patient was under F/U for four more years (nine years post PRK), but due to the severe corneal thinning and impending perforation, therapeutic PK was performed for the third time (Figure 3). At this time, VA reached hand motion due

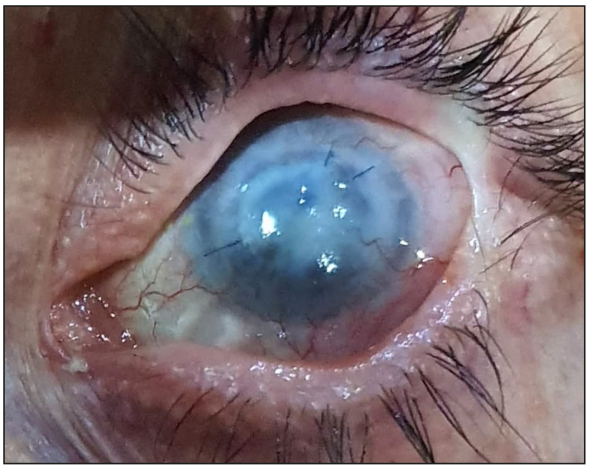

Figure 3. Case 3. 10 years after PRK.

to the prolonged and advanced glaucoma because of the patient's poor cooperation for F/U and her lack of using IOP lowering drops. Currently, IOP is normal in her both eyes, and the patient is under observation. Because of the lack of regular visits due to the patient's poor cooperation, it was impossible to take enough photos of her cornea.

Discussion

Corneal surgery by the excimer laser is a pivot procedure in keratorefractive surgery (e.g., PRK, LASIK, and LASEK)[10]. Infectious keratitis is a feared and devastating complication after excimer surface ablation similar to PRK, resulting in significant visual acuity loss in eyes with excellent visual potential[3,6,7].

Various studies have reported different incidences of infectious keratitis. Chang et al[6] found that the infection incidence after LASIK could vary widely from 0% to 1.5%. In the present study, definite culture-proven infectious keratitis was detected in three eyes of three patients with an overall rate of 0.046% per procedure. In a study by Leccisotti et al[11], the incidence of infectious keratitis after PRK was reported in five cases out of 25337 eyes (0.019%). Similarly, another study reported five cases of infectious keratitis after surface ablation in 25337 eyes (0.019%)[12]. However, higher rates of incidence are reported in many studies, including a rate of 0.21% (39 out of 18651 eyes), 0.1%, and 0.3% (13 out of 4492 eyes)[1,13,14]. On the other hand, the American Society of Cataract and Refractive Surgeons (ASCRS)[15] reported an incidence rate of 0.034%, which is in line with the rate obtained in the present study. In a university-based practice by Moshirfar et al[16], the incidence of nonviral infectious keratitis was reported in 10 out of 10477 eyes (0.095%). One of the most salient differences between later studies and previous ones is that they are conducted under strict adherence to published techniques and guidelines recommended by previous studies. De Rojas et al[1] compared the incidence of infectious keratitis after LASIK and PRK and found that this rate was 5.7 times higher in patients undergoing PRK (0.2% against 0.035%). Similarly, another study[2] demonstrated that the incidence of this condition was six times higher in patients undergoing PRK compared to those undergoing LASIK (0.066% against 0.011%) at the same centers. However, De Oliveira et al[14] conducted a study in a Brazilian clinic and found a two-fold incidence of infectious keratitis in patients undergoing PRK in comparison to those undergoing LASIK (0.2% against 0.1%). Unlike LASIK in which the epithelium remains intact after surgery, surface ablation procedures cause large epithelial defects, paving the way for the adherence and replication of infectious microbes. Thus, it is unsurprising that PRK is associated with an increased risk of microbial keratitis[3]. The application of topical corticosteroids and bandage contact lenses on an extended wear basis[17,18] for wound healing may suppress the immune system's ability and increase microbial keratitis risk[1].

Bacterial pathogens such as streptococcal and staphylococcal are the common organisms observed in early-onset infectious keratitis, but gram-negative organisms are rarely found in this type of infection. In late-onset infectious keratitis, however, opportunistic organisms such as Nocardia, fungi, and atypical mycobacteria are more common[7]. In our study, CPSA, CNSA, and CA were cultured in cases 1, 2, and 3, respectively. For early-onset keratitis (cases 1 and 2), it is recommended that a topical fluoroquinolone such as Levofloxacin 0.5% or Ofloxacin 0.3% (because of availability in Iran) be applied in a loading dose at five-minute intervals for three doses, and after then every 30 minutes, alternatively with an antimicrobial agent such as Vancomycin 50 mg/ml every 30 minutes. Today, because of the increased incidence of methicillin-resistant *S. aureus* (MRSA) in the general population, Vancomycin may be prescribed by physicians for better coverage of MRSA/MRSE[7]. To prevent collagenase production, Doxycycline 100 mg is typically administered twice a day, and it is recommended

the use of corticosteroids in a tapering manner be stopped. Based on several studies and drug availability in Iran, the recommended therapy for late-onset keratitis, which is usually caused by nocardia, fungi, and atypical mycobacteria, is to use topical Fluoroquinolone such as Ofloxacin 0.3% or Levofloxacin 0.5% in a loading dose at five-minute intervals for three doses, and after then every 30 minutes, alternatively with Amikacin 50 mg/ml at 30-minute intervals. It is also suggested to consume oral Doxycycline 100 mg two times per day and stop corticosteroids. In our study, according to the typical appearance of ulcer in case 3, which corresponded to candida keratitis and then was confirmed in the culture, Amphotericin B 0.25% was used in a loading dose at five-minute intervals for three doses, and then every 30 minutes[19].

In the current study, only one of the patients (case 3) required PKP due to the failure of treatment and progression of keratitis. The results of the 2001 survey of ASCRS members revealed that PKP was administered in 10 cases, while enucleation was used in one case. In the 2004 survey, transplantation was administered in three cases, and no cases required enucleation. However, in the 2008 survey, PKP was administered only in two cases and, again, no cases required enucleation[7]. In a study by Schallhorn et al[3], eight out of 645957 eyes required PKP. With the advancement of knowledge and experience, ophthalmologists have greater opportunities to deal with infections following refractive surgery. Rapid diagnosis at initial presentation and proper treatment regimen are effective in good visual recovery and prevent significant visual loss, thereby reducing the need for corneal transplantation and enucleation[1,6,7]. Moreover, preventive measures and a great deal of attention are critical from the preoperative to the postoperative stage. According to the literature, the potential risk factors of keratitis after surface ablation include blepharitis, health care environment, and contact lens manipulation[1,4,11,20].

Dry eye, previous trauma, and infectious conjunctivitis of her husband have also been suggested as keratitis risk factors[3]. Additionally, based on the report by Elizabeth et al[21], atypical organisms may not respond to empiric therapy, and organism identification is necessary for suitable management. We identified the patient's wife's healthcare environment and meibomian gland dysfunction (case 1), contact lens manipulation (case 2), and dry eye (case 3) as potential risk factors among the patients. These findings indicate the importance of having a proper preoperative clinical history and examining and treating the eyelids and dry eye disease[1,15]. A thorough examination of the eyelids and lacrimal apparatus of all patients is necessary before undergoing refractive surgery. Patients with blepharitis and infectious lid disease should be treated by applying warm compresses and a topical antibiotic ointment to the lid margin three times a day before they undergo keratorefractive surgery. Theoretically, this reduces the risk for bacterial keratitis through decreasing the bacterial load on the ocular surface and lids. Some surgeons have recommended monocular operations or the use of separate sets of instruments for bilateral laser surgery. Some surgeons have suggested that a 5% or 10% solution of povidone-iodine (betadine) can be applied to the eyelids before intraocular surgery (such as cataract surgery) to reduce the risk of postoperative endophthalmitis[7]. All laser surgeons and assisting technicians in Ardabil, Iran, (including the surgeon of the present study) use sterile masks, gloves, gowns, and drapes, just as for intraocular surgeries. The contamination of instruments can be prevented by using appropriate sterilization techniques. The fluids that are applied to the eyes should be fully disinfected before, during, and after refractive surgery. To reduce the risk of developing infectious keratitis in patients undergoing PRK, they should be warned about contaminated work environments, close contact with pets, and exposure to contaminated water until the epithelium heals[6].

In the present study, two eyes (cases 1 and 2) responded to medical therapy, but one eye (case 3) did not respond to the treatment and required corneal transplantation.

The current series' visual acuity results are reasonably satisfactory (CDVA of 20/25 in case 1 and UCDVA of 20/20 in case 2) and are consistent with those reported in other studies. In a study by Wroblewski et al[11] on five patients with infectious keratitis after PRK, the final CDVA was reported as 20/30, 20/25, 20/16, 20/20, and 20/20. In another study, Donnenfeld et al[4] investigated 13 cases and reported a final visual acuity between 20/20 and 20/100. CDVA was worse than 20/40 in two cases, was better in 11 cases, and was 20/20 in five cases, with one patient awaiting PKP. Similarly, de Oliveira[14] evaluated the final CDVA in nine cases with culture-proven infectious keratitis after PRK and found that it was 20/20 or better in seven cases and 20/40 or better in the remaining two cases.

One of the advantages of our study was that it was a prospective study. Furthermore, we pre-

sented the first case (case 1), to our knowledge, of post-PRK infectious keratitis in a well-known FMF case. Another advantage of our study was that one surgeon performed all surgeries and followed up all patients. Each of the patients could attend the scheduled follow-up visits in our private eye surgery clinic if any alteration was experienced by them from the last visit. In the case of developing a complication, most patients usually refer to their treatment center instead of asking for care from another center. However, some patients may also refer to other treatment centers. In a small province like Ardabil, there are a few surgeons conducting laser keratorefractive surgery, and rumors regarding postoperative infections are easily heard and spread across the city. In our opinion, the rate of incidence calculated in this study is reasonably accurate.

On the other hand, our study had some limitations. There was no professional camera to connect to a slit lamp to take photos of patients' eyes, and a mobile camera had to be used for this purpose in our clinic.

Conclusions

In summary, infectious keratitis is a sight-threatening complication after PRK and requires a wide range of topical antibiotic prophylaxis and treatment, including gram-positive coverage. Preserving good eye vision is possible in most patients through early and aggressive management (e.g., early culture, scraping, and intensive regimen of fortified topical antibiotic therapy) of this sight-threatening complication.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Not applicable.

Authors' Contributions

HO and AN conducted all experiments, analyzed and interpreted data, helped prepare the manuscript, and designed the study. All authors read and approved the final manuscript.

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Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Approval

All patients provided written informed consent for participation in the study, and this review received approval from the Ethic Committee of Ardabil University of Medical Sciences (IR.ARUMS.REC.1400.155). The research was performed in accordance with relevant guidelines/regulations of the Helsinki Declaration.

Informed Consent

Patients signed informed consent form and gave their approval to this study.

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