Bilateral Bacterial Keratitis in Three Patients Following Photorefractive Keratectomy

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ABSTRACT

PURPOSE: To report clinical manifestations and the bacteriologic profiles of three patients with bilateral bacterial keratitis following photorefractive keratectomy (PRK).

METHODS: Photorefractive keratectomy was performed for mild to moderate myopia or compound myopic astigmatism. Bandage contact lenses were fitted at the conclusion of each surgery. Bilateral infectious keratitis was diagnosed within 3 days after surgery. Smear and culture were obtained in all three cases. Patients were treated with topical fortified antibiotics (cefazolin and gentamicin).

RESULTS: All patients presented with severe bilateral ocular pain, photophobia, purulent discharge, and dense corneal infiltration. Causative organisms were Staphylococcus aureus (n=2) and Streptococcus pneumoniae (n=1). Ulcers were controlled with aggressive medical therapy in five eyes; however, tectonic penetrating keratoplasty was required in one eye.

CONCLUSIONS: Uncontrolled blepharitis and bandage contact lens use appears to play a role in the development of bacterial keratitis after PRK. Avoidance of simultaneous bilateral surgery in patients with risk factors for bacterial keratitis, preoperative control of blepharitis, and good contact lens hygiene is suggested. [J Refract Surg. 2007;23:312-315.]

Since the clinical approval of the excimer laser for refractive surgery, the application rate of this technology is increasing. Photorefractive keratectomy (PRK) is one of the most commonly performed refractive procedures and the safety and efficacy have been well proven.1 Photorefractive keratectomy was first introduced approximately 20 years ago, but due to its disadvantages (eg, severe pain and corneal haze) it was soon replaced by LASIK, which seemed to incur fewer complications. Unfortunately, because of long-term complications of LASIK, such as keratectasia, this procedure is used more cautiously. In recent years, application of anti-metabolites, such as mitomycin C (MMC), has decreased the incidence of corneal haze.2 In addition, treatment with nonsteroidal anti-inflammatory medications and bandage contact lens use has decreased the incidence of pain after PRK. Therefore, many ophthalmologists are reverting back to PRK.4

Infectious keratitis after PRK is a rare, but vision threatening, complication. There are 27 reports of infectious keratitis after PRK in the literature, but only two cases of bilateral keratitis.4-15 We present three patients with bilateral bacterial keratitis following PRK.

CASE REPORTS

CASE 1

A 45-year-old man underwent uneventful bilateral PRK without MMC for correction of low myopia (–3.00 diopters) in both eyes. At the end of surgery, a thermal...
apeutic contact lens was placed on each eye. The day after surgery, betamethasone 0.1% every 4 hours and chloramphenicol 0.5% and diclofenac sodium 0.1% every 6 hours were initiated. Two days later, the patient was referred to our center with severe ocular pain and purulent discharge bilaterally. On examination, visual acuity was hand motions in both eyes. Epithelial defects measuring 7.5×8.0 mm and 4×6 mm were present in the right and left eyes, respectively, with deep stromal infiltrates, tenacious discharge, stromal edema, and Descemet’s folds. A severe anterior chamber reaction (3+ to 4+ cells) was noted in both eyes, and a 0.5-mm hypopyon formation was observed in the right eye.

The patient was clinically diagnosed with bilateral bacterial keratitis and admitted. The contact lenses were removed. Smears from the corneal ulcers and purulent discharge showed polymorphic leukocytes, whereas staining was positive for gram-positive cocci in clumps. Aggressive medical therapy was immediately started with fortified gentamicin (14 mg/mL) and cefazolin (50 mg/mL) every 15 minutes, and subconjunctival injection of gentamicin (20 mg) and cefazolin (100 mg). Culture was positive for *Staphylococcus aureus* after 2 days.

The patient responded well to medical therapy. The size of the corneal epithelial defects decreased, stromal infiltrations reduced, and vision improved. Seven months after PRK, both corneas had faint and diffuse corneal opacities. Best spectacle-corrected visual acuity (BSCVA) was 20/50 and 20/40 with +2.25 −1.50 × 165° and +1.50 −1.25 × 175° in the right and left eyes, respectively.

**Case 2**

A 24-year-old man underwent uneventful bilateral PRK for mild compound myopic astigmatism. A bandage contact lens was fitted on each eye. The day after surgery, betamethasone 0.1% every 4 hours, chloramphenicol 0.5% every 6 hours, and diclofenac sodium 0.1% every 8 hours were initiated. The patient presented with severe bilateral ocular pain and purulent discharge in both eyes 2 days after surgery. Visual acuity was counting fingers in both eyes. Slit-lamp examination revealed a 5-mm epithelial defect in both eyes, and 4-mm and 3.5-mm deep central corneal infiltrates in the right and left eyes, respectively.

The patient was diagnosed with bilateral bacterial keratitis. The contact lenses were removed. Smear, culture, and confocal scanning microscopy were performed, which showed a large number of polymorphonuclear leukocytes. Aggressive medical treatment was initiated as described in case 1. Both eyes had severe blepharitis for which doxycycline 100 mg twice daily was started. Culture result was positive for *S aureus*. Corneal epithelial defects and stromal infiltrates began to improve slowly and antibiotics were gradually tapered. Superficial and deep vessels entered the cornea superiorly. Four months later, BSCVA was 20/30 in both eyes with refraction of +1.00 −1.50 × 15° in the right eye and +1.50 −1.75 × 180° in the left eye.

**Case 3**

A 28-year-old man who underwent bilateral PRK with MMC for myopic astigmatism was referred with a diagnosis of bilateral infectious keratitis. Visual acuity was counting fingers in the right eye and 20/400 in the left eye. Smear revealed gram-positive cocci, which culture showed to be *Streptococcus pneumoniae*. The condition improved in his left eye, but the right eye became worse. Lamellar resection of the ulcer, a large tectonic corneal graft was performed 4 days later. Two days after tectonic graft, total hyphema occurred, which led to mild corneal blood-staining on the next day. Anterior chamber washout was performed 18 days after admission. Four months later, the corneal graft was clear, the pupil was mildly dilated, and the lens was cataractous. Best spectacle-corrected visual acuity was 20/20 with +2.00 −5.00 × 45° in the right eye and 20/20 with +1.00 −1.25 × 160° in the left eye. A faint corneal scar was present in the left eye.

**Discussion**

Bacterial keratitis is a rare, but potentially devastating complication of PRK. In the past 15 years, infectious keratitis after PRK has been reported in 21 eyes of 25 patients. Donnenfeld et al. retrospectively reviewed the incidence of infectious keratitis in 13 eyes of 12 patients (mean age 28.4 years) from 3 refractive surgery centers. In all 13 eyes, culture was positive for *S aureus* (n=5), *S epidermidis* (n=4), *Streptococcus pneumoniae* (n=3), and *Streptococcus viridans* (n=1). Both eyes of 1 patient were infected with methicillin-resistant *S aureus*. No cases of gram-negative bacteria, opportunistic organisms, or fungi were reported.

In other reports, infectious keratitis after PRK was described in 14 eyes of 13 patients (Table). Causative organisms included *Mycobacterium chelonei* (n=4), mixed fungal infection (*Acremonium, Penicillium, Aureobasidium pullulans*) (n=1), *Aspergillus* and *Scopulariopsis* (n=2), *S aureus* and *S epidermidis* (n=4), *Streptococcus pneumoniae* and *viridans* (n=2).
and *Pseudomonas aeruginosa* (n=1). Only 1 case was reported to be bilateral.5,7,15 Based on these studies and the culture results of our study, it may be reasonable to assume that the most common organisms responsible for postoperative PRK infectious keratitis are gram-positive bacteria. Therefore, antibiotics effective in treating gram-positive bacteria should be considered for prevention of infection following PRK.

Aminoglycosides (gentamicin and tobramycin) and polymyxin B-trimethoprim (polytrim) have good coverage against gram-negative bacteria. Unfortunately, they are not effective on *S epidermidis* and streptococci, which constitute a major etiology of postoperative PRK bacterial infections.4 Fluoroquinolones are effective against gram-positive and gram-negative organisms. Their solubility is good and can penetrate into corneal tissue well. They are also effective on atypical mycobacteria species, which may occasionally be responsible for keratitis after PRK and LASIK. There is no report of bacterial keratitis after LASIK and PRK if ofloxacin or levofloxacin (a second and third generation fluoroquinolone) were used.4 Aside from being broad-spectrum, they have minimum side effects on wound healing. Fourth generation fluoroquinolones, including gatifloxacin and moxifloxacin, have better effectiveness on gram-positive organisms and seem to be the drug of choice to prevent postoperative PRK infections.4

In the report by Donnenfeld et al,4 prophylactic antibiotics prescribed were tobramycin, polymyxin B-trimethoprim, and ciprofloxacin. In our three cases, the prophylactic antibiotic was chloramphenicol, which is a broad-spectrum bacteriostatic agent and is effective for a variety of gram-negative and gram-positive bacteria.15

Aseptic conditions and sterile surgical instruments are crucial in the prevention of corneal infections after PRK.

Blepharitis, which was clinically obvious in our second case, is a predisposing factor for bacterial keratitis after PRK.17,18 Contact lenses, especially in the presence of blepharitis, increase the risk of this complication.18,19

The other important risk factor may be bandage contact lens use after PRK. Although reported cases of bacterial keratitis after PRK are limited, no study has proven that bandage contact lenses increase risk. The use of bandage contact lenses after PRK is controversial.20,21 If used, they should be removed within 3 to 7 days after surgery. They prevent mechanical irritation of the cornea induced by blinking and seem to reduce stimulation of free corneal nerve endings and thus reduce ocular pain, especially in the first 24 hours after surgery and accelerate corneal epithelial healing.9

Theoretically, contact lenses may increase the risk of infection after PRK. This may be due to reduction of

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**Table:**

<table>
<thead>
<tr>
<th>Study</th>
<th>Laterality</th>
<th>Prophylactic Antibiotic</th>
<th>Organism</th>
<th>BSCVA at Last Follow-up</th>
</tr>
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<tbody>
<tr>
<td>Brancato et al5</td>
<td>Unilateral</td>
<td>Tobramycin</td>
<td><em>Mycobacterium chelonae</em></td>
<td>20/20</td>
</tr>
<tr>
<td>Wee et al6</td>
<td>Unilateral</td>
<td></td>
<td><em>Pseudomonas aeruginosa</em></td>
<td>20/20</td>
</tr>
<tr>
<td>Sampath et al7</td>
<td>Unilateral</td>
<td></td>
<td><em>Streptococcus pneumoniae</em></td>
<td>CF</td>
</tr>
<tr>
<td>Amayem et al8</td>
<td>Unilateral</td>
<td>Chloramphenicol, Tobramycin</td>
<td><em>Staphylococcus epidermidis</em></td>
<td>20/30</td>
</tr>
<tr>
<td>Malling et al9</td>
<td>Unilateral</td>
<td>Gentamicin, Chloramphenicol</td>
<td><em>Streptococcus hemolyticus</em></td>
<td>CF</td>
</tr>
<tr>
<td>Fasching et al10</td>
<td>Unilateral</td>
<td></td>
<td><em>Aspergillus</em></td>
<td></td>
</tr>
<tr>
<td>Hill et al11</td>
<td>Unilateral</td>
<td>Co-trimoxazole</td>
<td><em>Staphylococcus aureus</em></td>
<td>20/100</td>
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<tr>
<td>Dunphy et al12</td>
<td>Unilateral</td>
<td>Tobramycin</td>
<td><em>Acremonium, Penicillium, Aureobasidium pullulans</em></td>
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<tr>
<td>Heidemann et al13</td>
<td>Bilateral</td>
<td>Ciprofloxacin</td>
<td><em>Staphylococcus aureus</em></td>
<td>20/80, 20/400*</td>
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<tr>
<td>Kouyoumdjian et al14</td>
<td>Unilateral</td>
<td>Polymyxin B-Neomycin-Bacitracin</td>
<td><em>Scopulariopsis</em></td>
<td>20/20</td>
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<tr>
<td>Waked and Ojeimi15</td>
<td>Unilateral</td>
<td></td>
<td><em>Culture negative</em></td>
<td>20/20</td>
</tr>
</tbody>
</table>

*BSVA = best spectacle-corrected visual acuity, CF = counting fingers.

*Right eye, left eye.*
the flow of tears behind the contact lens causing corneal hypoxia and accumulation of cellular debris on the eye surface, which provides optimal conditions for bacterial growth. In a study by Lim-Bon-Siong et al., complaints of redness, photophobia, and foreign body sensation were more prevalent in the group that used contact lenses after PKR.

In the study by Donnenfeld et al., all cases used soft contact lenses after surgery. Two patients had manipulated their contact lenses, and in two other cases contact lenses had been replaced without proper disinfection after they had fallen out. In our report, all patients used soft bandage contact lenses and there was no report of manipulation.

The corneal epithelium is removed during PKR; therefore, conjunctival and eyelid bacterial flora have direct access to underlying stroma. The corneal stroma is also exposed to bacteria on equipment, eye drops, contact lenses, aerosols, and the hands of medical personnel, which is why aseptic protocols, especially during epithelium removal and insertion of contact lenses, are of great importance. To prevent contamination, patients must also be informed of the appropriate technique for instillation of eye drops.

Patients’ occupations should also be considered before PKR. It appears that medical personnel are at higher risk for developing bacterial keratitis, and it is not to perform simultaneous bilateral surgery in these patients. None of our patients were medical personnel. However, in the study by Donnenfeld et al., two patients worked in medical centers (one was an intensive care unit nurse and the other was an internal medicine resident).

Each of our three patients was diagnosed on the second day after surgery. In one report, all cases were diagnosed within three postoperative days.

Careful, close follow-up is important and patients should be prompted to return if symptoms suggestive of bacterial keratitis occur. Contact lens removal is recommended as soon as possible after the epithelium has healed. We also suggest that surgery be performed in separate sessions for each eye in patients with increased risk for postoperative PKR infectious keratitis.

REFERENCES