The results found in this study are laser-specific and may be different in other laser platforms. Some lasers (such as the NIDEK EC-5000) use nitrogen gas to purge the laser beam path, making them less sensitive to environmental changes. Other lasers do not use nitrogen purge and may be more sensitive to room conditions.

The variations seen in PMMA test ablations may not translate completely into clinical changes. Regarding tissue characteristics and specificity, stromal tissue may be more sensitive to environmental changes than PMMA because of the differences in ablation thresholds and the effects of dehydration.

REFERENCES

CONCLUSIONS: Nocardia, a relatively unusual organism, can cause an epidemic of infection after LASIK. [J Refract Surg. 2007;23:309-312.]

Although the safety of LASIK is well proven, it can be complicated by sight-threatening infections. Case reports and case series of postoperative infections have been reported in the literature. In the majority of cases, inoculation of microorganisms occurs during surgery as a result of intraoperative asepsis breach or presence of septic focus in and around the eye. Gram-positive bacteria and mycobacteria are the most common organisms isolated from these cases. Other less common organisms are gram-negative bacteria, fungi, and Acanthamoeba. Four cases of Nocardia infection after LASIK have been reported in the literature. We report a cluster of three cases of Nocardia infection after LASIK in patients operated at the same surgical center on the same day.

PATIENTS AND METHODS
Three patients were referred to the Cornea Service of L V Prasad Eye Institute, Hyderabad, India, with a diagnosis of keratitis after LASIK. We obtained a patient history and performed a detailed examination of all eyes, noting specifically the size, nature, and extent of the infiltrate, status of the surrounding cornea, anterior chamber reaction, and status of the posterior segment. Corneal scrapings were obtained from all affected eyes using a #15 surgical blade after raising the lamellar flap. The material obtained was subjected to a detailed microbiologic examination as previously described. After scraping, the stromal bed was irrigated with cefazolin (5%) and amikacin (2.5%) solutions. At the end of the procedure, the flap was repositioned in all eyes. A bandage contact lens was applied in one eye to keep the flap in place. All patients were treated with hourly instillation of cefazolin (5%) and amikacin (2.5%) eye drops, based on microscopic examination.

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of the smears. All patients were examined daily using slit-lamp microscopy, and their response to treatment was recorded. Treatment was modified based on the clinical response and results of the culture and sensitivity. One week after beginning treatment, the right eye of one patient (case 1) developed flap necrosis with clinical worsening. Therefore, we excised the corneal flap to facilitate drug penetration. The flap was submitted for histopathologic examination in formalin.

**RESULTS**

A single surgeon performed LASIK on all patients on the same day in the same operating room. The surgeries were performed 10 days before the patients presented to our service. Two patients (cases 1 and 2) underwent surgery for myopia, whereas one patient (case 3) had hyperopic LASIK. Cases 1 and 3 underwent bilateral simultaneous procedures, and case 2 underwent unilateral LASIK for unilateral myopia. Postoperatively, all patients received tobramycin and fluoromethalene eye drops 4 times daily. Patients developed pain, redness, irritation, and watering of the eye 3 to 5 days after the surgery. One patient (case 1) had symptoms in both eyes. After the onset of symptoms, two patients (cases 1 and 2) were managed with frequent instillation of topical corticosteroids for the diagnosis of diffuse lamellar keratitis.

Clinical findings are described in the Table and shown in the Figure. Microscopic examination of smears from all eyes revealed thin, branching, gram-positive, 1% acid-fast, beaded filaments suggestive of *Nocardiodes*. Results of cultures showed dry, chalky-white tiny colonies on blood and chocolate agar plates within 24 hours of inoculation that were identified as *Nocardia asteroides*. On in vitro antimicrobial susceptibility testing, these organisms were sensitive to amikacin, chloramphenicol, vancomycin, and ciprofloxacin. Administration of fortified cefazolin was discontinued after 3 days and topical (1:5 ratio in intravenous preparation) and oral cotrimoxazole (trimethoprim-sulfamethoxazole) were added to the treatment regimen. The course of therapy and outcome for all eyes are shown in the Table. No recurrent infection occurred after 6-month follow-up.

The primary surgeon disclosed that four patients were operated on the same day, and the fourth patient

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### TABLE

<table>
<thead>
<tr>
<th>Patients</th>
<th>Presenting Visual Acuity</th>
<th>Findings</th>
<th>Initial Treatment</th>
<th>Treatment Modification</th>
<th>Treatment Duration (wk)</th>
<th>Final Outcome</th>
<th>Complications During Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1 Right eye</td>
<td>CF at 2 meters</td>
<td>Multiple round gray-white infiltrates</td>
<td>Cefazolin 5% and amikacin 2.5% half hourly, atropine sulfate 1% TDS</td>
<td>Day 4 - cefazolin stopped, cotrimoxazole half hourly added Day 8 - flapotomy, amikacin wash, bandage contact lens Day 12 - amikacin stopped, oral cotrimoxazole twice daily added</td>
<td>7</td>
<td>Healed, 20/60</td>
<td>Flap necrosis, amikacin toxicity</td>
</tr>
<tr>
<td>Left eye</td>
<td>6/24</td>
<td>Multiple round gray-white infiltrates</td>
<td>Cefazolin 5% and amikacin 2.5% half hourly, atropine sulfate 1% TDS</td>
<td>Day 4 - cefazolin stopped, cotrimoxazole half hourly added Day 12 - amikacin stopped, oral cotrimoxazole twice daily added</td>
<td>7</td>
<td>Healed, 20/50</td>
<td>None</td>
</tr>
<tr>
<td>Case 2 Right eye</td>
<td>20/20p</td>
<td>2 pinhead-sized infiltrates near flap hinge</td>
<td>Cefazolin 5% and amikacin 2.5% half hourly, atropine sulfate 1% TDS</td>
<td>Day 4 - cefazolin stopped, cotrimoxazole hourly added Day 12 - amikacin stopped, oral and topical cotrimoxazole twice daily added</td>
<td>7</td>
<td>Healed, 20/80p</td>
<td>Waxing and waning course, amikacin toxicity</td>
</tr>
<tr>
<td>Case 3 Right eye</td>
<td>20/20p</td>
<td>2 pinhead-sized infiltrates in central cornea</td>
<td>Cefazolin 5% and amikacin 2.5% half hourly, atropine sulfate 1% TDS</td>
<td>Day 4 - cefazolin stopped, cotrimoxazole hourly added Day 15 - amikacin stopped, oral cotrimoxazole twice daily added</td>
<td>6</td>
<td>Healed, 20/25p</td>
<td>Pseudo-membranous conjunctivits, amikacin toxicity</td>
</tr>
</tbody>
</table>

*CF = counting fingers, p = partial, TDS = three times daily*
underwent bilateral LASIK for myopia. After three patients were diagnosed with infection, he recalled the fourth patient and found bilateral keratitis as well. The primary surgeon managed this patient with a similar course of treatment as ours (ie, amikacin and cotrimoxazole administration), and the infiltrate finally resolved. He also disclosed that all cases were operated using the same blade and microkeratomes. Case 1, with bilateral infection, was the first patient who underwent surgery on that day, followed by case 4 (not examined by us), and case 3, with the mildest infection, was the last to be operated.

DISCUSSION

*Nocardia* belongs to the order Actinomycetales and are aerobic, gram-positive, filamentous bacteria that exist ubiquitously in the environment. Ocular infections by *Nocardia* are relatively rare but have been reported in the spectrum of disease entities such as keratitis, scleritis, and endophthalmitis. A search of the English literature revealed only four reports; each describing one case of *Nocardia* infection after LASIK. Two of these reported cases occurred after retreatment, whereas in another case infection occurred after trauma. In our report, infection occurred in all cases after primary surgery and was most likely due to intraoperative contamination. Because the same instruments were used for all eyes, contamination resulted in a cluster of *Nocardia* infections. It is interesting that the infection was the most severe in the first patient and that severity decreased in subsequent patients.

Another important aspect of this report is that infection occurred in all cases operated on the same day (epidemic). In reviewing English ophthalmic literature, we could find only three reports of epidemic of infection after LASIK. In these reports, atypical mycobacteria were responsible for the infections; however epidemic caused by *Nocardia* after LASIK has not been reported. Although we could not investigate the source of epidemic of infection, it seems obvious that the use of the same instruments in different patients was the risk factor.

Although infection after LASIK is a rare complication, it can result in moderate to severe visual loss. Because this procedure is performed in relatively young, healthy individuals with a potentially long life span, any major compromise in visual acuity could have a negative impact that prevents them from leading an active life. Therefore, it is important to prevent this type of complication, but if it occurs to limit visual loss through early diagnosis and treatment. It is the responsibility of physicians to report all such complications as to better understand the clinical presentations, risk factors, etiology, and management.

Our report further highlights the importance of strict asepsis in all refractive surgery procedures. This includes the single use of all instruments, including microkeratomes and blades, for each patient as well as in both eyes of the same patient while performing simultaneous bilateral surgery.
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. Photorefractive keratectomy was first introduced approximately 20 years ago, but due to its disadvantages (e.g., 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. 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.

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. 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 diptors) in both eyes. At the end of surgery, a thera-