Infectious keratitis after laser in situ keratomileusis: Results of an ASCRS survey

Renée Solomon, MD, Eric D. Donnenfeld, MD, Dimitri T. Azar, MD, Edward J. Holland, MD, F. Rick Palmon, MD, Stephen C. Pflugfelder, MD, Jonathan B. Rubenstein, MD

To investigate the incidence, culture results, treatment, and visual outcomes of infectious keratitis after laser in situ keratomileusis (LASIK) worldwide, the Cornea Clinical Committee of the American Society of Cataract and Refractive Surgery (ASCRS) contacted 8600 United States and international ASCRS members by e-mail and asked them to respond to a questionnaire about post-LASIK infectious keratitis. One hundred sixteen infections were reported by 56 LASIK surgeons who had performed an estimated 338 550 procedures. Seventy-six cases presented in the first week after surgery, 7 during the second week, 17 between the second and fourth weeks, and 16 after 1 month. Forty-seven cases were not diagnosed on initial presentation. The most common organisms cultured were atypical mycobacteria and staphylococci. Empiric therapy is not recommended as most of the organisms are opportunistic and not responsive to conventional therapy. Flap elevation and culturing should be performed when post-LASIK infectious keratitis is suspected.


Laser in situ keratomileusis (LASIK) is the most commonly performed refractive surgical procedure since it offers many advantages over photorefractive keratectomy (PRK) for the correction of ametropia including rapid visual rehabilitation, decreased stromal scarring, less irregular astigmatism, minimal regression, less postoperative pain, and the ability to treat a wider range of refractive disorders. Unlike PRK, LASIK preserves the integrity of Bowman’s membrane and the overlying epithelium, thus decreasing the risk for microbial keratitis. However, microbial keratitis after LASIK has become an increasingly recognized, sight-threatening complication of refractive surgery. The incidence of infectious keratitis after LASIK is unknown. In most cases, it is not possible to determine the origin of the infection. Predisposing factors include a history of corneal surgery, breaks in the epithelial barrier, excessive surgical manipulation, intraoperative contamination, delayed postoperative reepithelialization of the cornea, and use of topical steroids.

The American Society of Cataract and Refractive Surgery (ASCRS) Cornea Clinical Committee developed a post-LASIK infectious keratitis survey. The pur-
pose was to investigate the worldwide incidence, culture results, treatment, and visual outcomes of infectious keratitis after LASIK among LASIK surgeons who are ASCRS members. The results of the survey are presented in this report.

**Materials and Methods**

In November 2001, the ASCRS Cornea Clinical Committee sent an e-mail to 8600 U.S. and international ASCRS members asking them to respond to a questionnaire about infectious keratitis after LASIK (Figure 1). The responses were confidential. The LASIK surgeons were asked to complete the questionnaire and e-mail their responses. No financial incentive was provided for returning the questionnaire. Survey results received by the deadline of January 1, 2002, were tabulated in a Microsoft Excel 2000 database developed for this survey.

**Results**

One hundred sixteen post-LASIK infections were reported by 56 LASIK surgeons who had performed an estimated 338,550 procedures. This corresponded to an incidence of 1 infection in every 2919 procedures performed by surgeons returning the questionnaire. Seventy-six cases presented in the first week after surgery, 7 in the second week, 17 between the second and fourth weeks, and 16 after 1 month (Figure 2).

The most common organisms cultured were atypical mycobacteria and staphylococci (Table 1 and Figure 3). In 46 of the 69 eyes that were culture positive, the flaps were elevated and scraped for cultures. In 23 of the 69 eyes, the cultures were obtained without lifting the flap. Forty-seven of the 116 cases were not diagnosed on initial presentation. There were 3 clusters of mycobacteria with 3 or more cases in the same clinical setting within 1 month. Nine patients required flap excision, and 1 flap sloughed spontaneously. Figures 4 and 5 show the uncorrected (UCVA) and best corrected (BCVA) visual acuity, respectively. Thirty-seven patients maintained their BCVA, and 11 had a BCVA of 20/40 or worse. One case required enucleation. Ten cases required penetrating keratoplasty for visual rehabilitation. Figure 6 shows the number of infections relative to the LASIK surgical volume.

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**Figure 1.** (Solomon) ASCRS Cornea Clinical Committee Infectious Keratitis Following LASIK Questionnaire.

**Figure 2.** (Solomon) Day of infectious keratitis presentation.

**Figure 3.** (Solomon) Culture results of post-LASIK infectious keratitis.
Discussion

This is the first survey that provides information about post-LASIK infectious keratitis. The incidence, culture results, treatment, and visual outcomes of infectious keratitis after LASIK worldwide among ASCRS LASIK surgeons are summarized. Our culture results are similar to those in cases reported in the literature (Table 1, Figures 3 and 7) and emphasize the prevalence of atypical mycobacteria species and gram-positive bacteria as the most common organisms recovered in infectious keratitis after LASIK. We believe that responses by 56 LASIK surgeons who had performed an estimated 338,550 procedures from a worldwide geographic distribution provide representative information.

Limitations of the survey are the inability to identify whether the information from respondents differed from the experience of nonrespondents; the retrospective, noncontrolled nature of the study; that it did not provide sensitivities of the organisms; non-ASCRS members were not considered; and only 56 of 8500 ASCRS members stated they had experienced infections. Therefore, most surgeons have not experienced a post-LASIK infection. Our incidence of 1 in 2919 considers only responding ophthalmologists who encountered infections after LASIK and includes culture-negative and uncultured eyes. No attempt was made to

<table>
<thead>
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<th>Infectious Agent</th>
<th>Number of Cases in Literature Reports</th>
<th>Number of Cases in ASCRS Survey</th>
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<tr>
<td>Bacterial</td>
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<td>26</td>
</tr>
<tr>
<td>Not cultured</td>
<td>0</td>
<td>21</td>
</tr>
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</table>

Table 1. Post-LASIK infectious keratitis cases reported in the literature and the ASCRS survey.

Figure 4. (Solomon) Uncorrected visual acuity in infectious keratitis cases.

Figure 5. (Solomon) Best corrected visual acuity in infectious keratitis cases.

Figure 6. (Solomon) Number of infections relative to LASIK surgical volume.

Figure 7. (Solomon) Culture results of post-LASIK infectious keratitis reported in the literature.
estimate the actual incidence of infectious keratitis because ophthalmologists who did not experience infectious keratitis were not considered. The true incidence is probably significantly lower.

Infectious keratitis is a potentially severe complication of LASIK. A high degree of suspicion coupled with rapid diagnosis and appropriate therapy can result in visual recovery. We recommend lifting, scraping, and culturing all cases of post-LASIK keratitis that appear infectious; selecting appropriate culture media including blood agar, chocolate agar, Sabouraud’s agar, thioglycolate broth, and Löwenstein-Jensen; and staining scrapings with Gram, Gomori’s methenamine silver, and Ziehl-Neelsen to rule out unusual pathogens such as Nocardia, atypical mycobacteria, and fungi (Figure 8). We strongly recommend the use of Löwenstein-Jensen medium as it will grow atypical mycobacteria and Nocardia, the most common organisms seen after LASIK, whereas the other media may not support these organisms.

For the treatment of rapid-onset and delayed-onset infectious keratitis, we recommend the following: elevate the flap, culture, and irrigate the stromal bed with antibiotic solution. For rapid-onset keratitis, we recommend fluoroquinolone every 30 minutes alternating with vancomycin 50 mg/mL every 30 minutes, oral doxycycline 100 mg twice daily, and discontinuing corticosteroids. Alternative therapy for delayed-onset keratitis, which would cover atypical mycobacteria, includes clarithromycin and fourth-generation fluoroquinolones. Treatment should be modified based on culture and scraping results. Any focal infiltrate after LASIK should be considered infectious until proved otherwise (Figure 9).

In conclusion, the culture results revealed opportunistic infections and gram-positive bacteria as the most common organisms. Antibiotic prophylaxis for LASIK should emphasize the need to provide broad-based spectrum coverage with gram-positive emphasis. Current prophylactic antibiotics are not effective against atypical mycobacteria. There is a need to develop antimicrobials to treat these organisms. Fourth-generation fluoroquinolones should be considered in the armamentarium of prophylactic antibiotic agents. Infectious keratitis may present as late as 1 month after LASIK, and its frequent misdiagnosis at initial presentation may result in significant vision loss. We do not recommend empiric therapy as most organisms are opportunistic and do not respond to conventional therapy. We do recommend a high degree of suspicion with flap elevation and culturing of all eyes suspected of infectious keratitis after LASIK.

We hope the information in this report will assist LASIK surgeons in assessing their approaches to the management of post-LASIK infectious keratitis. It provides baseline information from which new trends in post-LASIK infectious keratitis may be identified in future surveys and increases the availability of information.
to all ophthalmologists. The goal is to standardize treatment, minimize visual loss, and improve outcomes.

References
31. Al-Reefy M. Bacterial keratitis following laser in situ...