Association Between Cultures of Contact Lens and Corneal Scraping in Contact Lens–Related Microbial Keratitis

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Objective: To study the association between cultures of contact lens and corneal scraping in contact lens–related microbial keratitis.

Methods: A retrospective analysis of the culture results of corneal scrapings and contact lenses of patients with contact lens–related microbial keratitis who were initially seen at Royal Victorian Eye and Ear Hospital, Melbourne, Australia, between January 1, 2001, and December 31, 2004, was conducted.

Results: Fifty eye specimens of 49 patients were included in the study. Corneal scrapings and contact lenses were culture positive in 17 eyes (34%) and in 35 eyes (70%), respectively. In 13 eyes, corneal scrapings and contact lenses yielded identical organisms. Serratia marcescens was the most common organism isolated from the corneal scrapings and from the contact lenses.

Conclusion: Contact lens culture may sometimes give a clue to the organism involved in cases of microbial keratitis in which the corneal scraping is culture negative and may help in choosing the appropriate antimicrobial therapy.

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CONTACT LENS WEAR IS ASSOCIATED with a significant risk of microbial keratitis leading to severe sight-threatening complications. Microbial keratitis has been seen in all types of lenses, including rigid gas-permeable lenses, hard or polymethylmethacrylate lenses, and high- and low-oxygen transmissibility soft lenses, as well as with all modes of wear, including daily wear, extended wear, therapeutic wear, and continuous wear. Patients using soft contact lenses are at greater risk of developing microbial keratitis than those using other lenses.

Different organisms have been associated with contact lens–related microbial keratitis. Compared with non–contact lens–related microbial keratitis, gram-negative rods are more prevalent in contact lens–related microbial keratitis. We undertook this study to investigate the association between cultures of contact lens and cultures of corneal scraping in cases of contact lens–related microbial keratitis.

The clinical records of all soft contact lens–related microbial keratitis at the Royal Victorian Eye and Ear Hospital, Melbourne, Australia, where the corneal scrapings and the contact lenses were sent for culture from January 1, 2001, to December 31, 2004, were reviewed. Patients using therapeutic contact lenses were excluded from this study. The following data were collected from each medical record: age, sex, clinical manifestation, microbiological results, and any predisposing factor (other than the routine contact lens care).

All patients had undergone detailed clinical evaluation and slitlamp examination. The ulcers were routinely scraped for Gram-stained and fluorescent brightener–stained (Blankophor; Bayer, Wuppertal, Germany) smears and for plating on blood agar, chocolate agar, Sabaroud dextrose agar, thioglycollate broth, and nonnutrient agar. For culture, contact lenses were sent in sterile water in a sterile container. If the patient was not wearing the contact lenses during the initial visit, contact lenses were sent in the patient’s contact lens case for the culture. In the laboratory, the contact lens cases were opened without touching the interior, and a sterile swab or loop was used to culture the solution in the case. If the contact lens case was dry, a sterile cotton-wool swab moistened with sterile isotonic sodium chloride solution was used to swab the interior of the case. Intensive topical antimicrobial therapy was initiated immediately after the corneal scrapings were sent for microbiological investigations. Treatment was modified according to the microbiological findings, whenever required.

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Fifty eyes of 49 patients with contact lens–related microbial keratitis were included in the present study. One patient had simultaneous involvement of both eyes. The mean ± SD age was 34 ± 12 years (age range, 17-59 years).

Seventeen corneal scrapings (34%) and 35 contact lenses (70%) were culture positive (Table 1), and of these, 13 corneal scrapings (76%) yielded organisms identical to the ones grown in their contact lens cultures. In 2 eyes, different organisms were isolated from the corneal scrapings and the contact lenses. In 2 eyes, only the corneal scrapings were culture positive.

*Streptococcus pneumoniae* was the most common organism in the corneal scrapings (n = 9) and in the contact lenses (n = 19), followed by *Pseudomonas aeruginosa* (Table 2). In 1 corneal scraping (2%) and in 8 contact lenses (16%), multiple organisms were isolated.

Fluorescent brightener–stained smears were positive for *Acanthamoeba* cysts in the corneal scrapings and in the contact lenses of 2 eyes. *Acanthamoeba* species was cultured from 1 corneal scraping and from 2 contact lenses. Four contact lenses (1 *Candida albicans*, 2 yeasts other than *C albicans*, and 1 *Paeilomyces* species) were culture positive for fungus.

In 11 eyes, ulcer was restricted to the peripheral cornea. Of these, corneal scrapings were culture positive in 1 eye (9%). In the remaining 39 eyes, infiltrate was localized to the central cornea or to the midperipheral to peripheral cornea, and of these, corneal scrapings were culture positive in 16 of 39 cases (41%).

In 27 patients, contact lenses of both eyes were sent for culture. Of these, identical organisms were cultured for the contact lenses of both eyes in 21 patients. In 5 patients, the contact lenses of both eyes did not yield any organism, and in 1 patient, the contact lenses yielded different organisms. Among 10 patients who were using topical antibiotics at the initial visit, 4 corneal scrapings and 7 contact lenses were culture positive.

### RESULTS

<table>
<thead>
<tr>
<th>Culture</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Lens</td>
<td>15</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>Corneal Scraping</td>
<td>2</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>33</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 1. Cultures of Corneal Scrapings and Contact Lenses Among 49 Patients With Contact Lens–Related Microbial Keratitis

*An association is demonstrated between the corneal scraping culture and contact lens culture (χ² = 4.079, P < .001, McNemar test).*

Various risk factors that can lead to microbial keratitis include ocular trauma, contact lens wear, eyelid malalignment, ocular surface diseases, and corticosteroid use (including topical corticosteroids).10 Contact lens–related corneal infections continue to be a major challenge to ophthalmologists and to lens care practitioners. With continuous improvement in the lens material and design, as well as in disinfecting and storing solutions, contact lens use is on the rise. However, it has become a major predisposing factor for microbial keratitis, contributing to more than 30% of cases in some published studies.11,12

The major risk factor for contact lens–related microbial keratitis is overnight use of soft contact lenses; the risk increases incrementally with the number of nights of continuous wear. Higher risks have also been related to smoking, male sex, and lower socioeconomic status.13 However, in our series, there were more women (27 of 49 [55%]) with contact lens–related microbial keratitis. Patient sex and duration of overnight wear have been reported to be associated with microbial keratitis, whereas patient age and socioeconomic status were associated with sterile keratitis.14 Silicone hydrogel lenses carry 5 times decreased risk of developing severe keratitis associated with extended wear compared with hydrogel lenses.15 The incidence of loss of visual acuity caused by microbial keratitis is low in silicone hydrogel contact lens users.16 Compliance of patients and contamination of contact lenses and contact lens products are significant risk factors.17 The most frequently contaminated item used in the care of contact lenses is the disinfectant and storage case.18,19

The propensity of bacteria to adhere to soft contact lenses in areas of deposits has been noted by some authors.20,21 Bacterial adhesion to contact lenses may depend on the soft contact lens material.22 Effective enzymatic cleaning of mucin-coated hydrogel lenses has been shown to reduce the adherence of *Pseudomonas* to the lens.23 However, electron microscopic findings have shown that the contact lens coating on worn soft contact lenses is not completely removed using surfactant or enzymatic cleaners.24 Firm adherence of *Acanthamoeba* cysts and trophozoites to soft contact lenses has also been demonstrated.25

Standard investigations of microbial keratitis include corneal scraping. Incidences of negative culture results from corneal scrapings of suspected bacterial keratitis and of ulcerative keratitis have been reported to be 23%26 and 53%,27 respectively. Lam et al28 found 36% of corneal scrapings to be culture positive in cases of contact lens–related microbial keratitis, which is comparable to our percentage (34% [17 of 50 specimens]), whereas Bourcier et al29 reported it to be 63%. Patients with peripheral infiltrates tend to have fewer positive results of corneal scraping cultures, varying from 9%30 to 25%.31 In our series, corneal scraping cultures were positive in 1 of 11 cases with peripheral infiltrates (9%).

In the event of contact lens–related microbial keratitis, we have an additional diagnostic technique of contact lens culture in our armamentarium. Mela et al32 demonstrated the importance of culture of contact lenses and of contact lens storage solutions in addition to the corneal scrapings. They found that 67% of the negative corneal scraping cases were positive on contact lens culture. In our series, 20 of the 50 negative corneal scraping cases (40%) were positive on contact lens culture. Conversely, in 2 eyes, corneal scraping culture was positive,
but contact lens culture was negative. This may be because the contact lenses were sent in isotonic sodium chloride solution (washing off a small number of organisms on it) rather than in their case.

Contact lens culture helps in providing some vital clues, especially in the situation in which corneal scraping results are negative and the patient is already taking a broad-spectrum antibiotic at the initial visit. However, these results should be interpreted with caution, keeping common contaminants in mind.

Although *Pseudomonas aeruginosa* is the most frequently isolated pathogen from contact lens–related corneal infections, in our study *S. marcescens* was the most common organism isolated from corneal scrapings and from contact lenses. *Serratia marcescens* can survive in solutions preserved with chlorhexidine gluconate and benzalkonium chloride. Alexandrakis et al identified *S. marcescens* as the second most common gram-negative isolate in microbial keratitis. However, among the contact lens wearers, it equaled *Pseudomonas* as the most common isolates. These authors documented a shifting trend in the type of organism (the number of *Pseudomonas* cases seems to be decreasing over time) in contact lens–associated ulcerative keratitis. Cohen et al also documented a decrease in the number of *Pseudomonas* infections in contact lens patients. This may be owing to the fact that more emphasis is being given to developing strategies aimed at *Pseudomonas* elimination; hence, the incidence of other water-borne organisms such as *Serratia* and others is increasing.

*Serratia marcescens* keratitis is known to be associated with abnormal ocular surface, use of topical medication, and contact lens wear. The ability of *S. marcescens* to resist phagocytosis and to grow to high levels in the presence of polymorphonuclear leukocytes, particularly when grown on contact lenses, may be a mechanism by which this bacterium can survive the ocular defense system. Like *Pseudomonas*, *Serratia* is inherently resistant to several antimicrobial agents and is capable of readily acquiring resistance.

Martins et al reported an overall concordance of 84% between cultures obtained from corneal scrapings and from contact lenses. Our results demonstrate an association between the corneal scraping culture and contact lens culture (P <.001). In our study, the lower positive rate of corneal scraping culture compared with contact lens culture might be partly owing to culture of all the corneal scrapings in presumed contact lens–related microbial keratitis irrespective of their size. Prior use of antibiotics before the corneal scraping is taken, as well as the propensity of bacterial adherence to contact lens, could be responsible for the discrepancy between the culture results of corneal scrapings and contact lenses. Furthermore, this is a retrospective analysis of data, and a prospective study may help clarify some discrepancies.

Donzis et al found that in 52 of 100 asymptomatic patients, some elements of the contact lens care system were contaminated with microorganisms. In our study, 21 patients’ contact lenses of the unaffected eyes grew similar organisms as those of the affected eyes.

Our study highlights the fact that contact lens culture may help in identification of the causative organism in many cases of contact lens–related microbial keratitis. Also, contact lens culture may give a clue regarding the identity of the causative organism in situations in which the corneal scraping is culture negative and may help in choosing the appropriate antimicrobial agent. However, contact lens cultures cannot replace the corneal scraping cultures, a gold standard for the causative diagnosis of microbial keratitis, and caution must be exercised in interpreting these results.

### Table 2. Culture Results From Corneal Scrapings and Contact Lenses

<table>
<thead>
<tr>
<th>Result</th>
<th>Total Isolates From Corneal Scrapings and Contact Lenses (X+Y)</th>
<th>Positive Contact Lens Culture (X)</th>
<th>Positive Corneal Scraping Culture (Y)</th>
<th>Positive Contact Lens Culture and Corneal Scraping Culture (Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gram-Negative Bacilli</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Serratia marcescens</em></td>
<td>28</td>
<td>19</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><em>Serratia liquefaciens</em></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mixed gram-negative rods</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other gram-negative rods</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Gram-Positive Coci</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Coagulase-negative staphylococci</td>
<td>10</td>
<td>3</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td><strong>Gram-Positive Bacilli</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Corynebacterium species</em></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Fungi</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Candida albicans</em></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other yeast</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Paecilomyces species</em></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Amoeba</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Acanthamoeba</em></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*One corneal scraping and 8 contact lenses yielded multiple organisms.*
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