Microbial Changes in Conjunctival Flora with 30-Day Continuous-Wear Silicone Hydrogel Contact Lenses

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Purpose. To determine the effect of 30-day continuous-wear silicone hydrogel contact lenses on the conjunctival flora in asymptomatic wearers. Methods. The authors studied 29 eyes of 15 patients wearing Focus NIGHT & DAY silicone hydrogel contact lenses for up to 30 nights of continuous wear. The average age of the patients was 25.54 ± 8.98 years. Cultures of the inferior cul-de-sac were taken bilaterally from all eyes, before and after lens wear in asymptomatic patients. The isolation and identification of bacteria were made by standard clinical laboratory methods. Results. The number of eyes whose conjunctival cultures were sterile before using the lenses significantly decreased (P = 0.0005), and the number of eyes with a growth of coagulase-negative staphylococci and diphtheroid rods in their conjunctival cultures significantly increased after using these lenses (P = 0.001 and P = 0.031, respectively). Conversely, a statistically significant difference was not found in the number of eyes that carried Propionibacterium acnes and Fusobacterium nucleatum in their conjunctival cultures before and after using the 30-day continuous-wear silicone hydrogel lenses (P = 0.998 and P = 0.488, respectively). Conclusions. The results suggest that the sterility of the conjunctiva significantly decreased after using 30-day continuous-wear silicone hydrogel contact lenses. In addition, the number of bacteria of the normal conjunctival flora significantly increased after the use of these lenses. Contamination by the bacteria of the eyelids may be a possible colonization factor in this study group. Therefore, it is appropriate to examine the patients who wear these lenses more frequently.

Key Words: Conjunctival flora—Contact lenses—Microbial changes.

The predominant isolates recovered from the eyelids and conjunctiva are Staphylococcus epidermidis, Staphylococcus aureus, Corynebacterium species, and Propionibacterium acnes.1 One of the reasons for the disruption of the eyes' physical defenses can occur by contact lens wear because of the micro-trauma of the epithelium.2 Contact lenses can serve as a reservoir for potential pathogenic bacteria. Consequently, they promote the adherence of these bacteria to the predisposed ocular surface.3

The aim of this study was to determine the effect of 30-day continuous-wear silicone hydrogel contact lenses on the normal conjunctival flora in asymptomatic wearers.

MATERIALS AND METHODS

We studied, microbiologically, 29 eyes of 15 patients wearing 30-day continuous wear Focus NIGHT & DAY (CIBA Vision, Duluth, GA) contact lenses. The technical data of the lenses are shown in Table 1.

Patients with any corneal or ocular disease were excluded from the study at the first prefitting examination. The average age of the patients was 25.54 ± 8.98 years (range, 10–43 years). Before lens wear, cultures of the inferior cul-de-sac from all eyes were taken by using sterile cotton swabs. The same analysis was repeated for cultures in the same asymptomatic patients having used 30-day continuous-wear Focus NIGHT & DAY contact lenses. Although samples were taken, contact lenses were not removed. Both cultures were taken by the same specialist.

For the isolation and identification of bacteria, the cul-de-sac material was taken by two cotton swabs from each eye and put into a Cary and Blair transport medium and was sent to the microbiology laboratory. For the isolation of aerobic bacteria, one of the swabs was taken from the transport media and was inoculated on sheep blood agar, chocolate agar, and McConkey agar.3 These agar media were incubated for 48 hours at 37°C. The identification of aerobic bacteria was made by standard clinical laboratory methods, and the results were confirmed by analytical profile index (API) panels (bioMérieux, Marcy l’Etoile, France).

For the isolation of anaerobic bacteria, the second swab was taken from the transport media and was inoculated onto anaerobic blood agar, phenylethyl alcohol blood agar, and kanamycin-vancocin blood agar prepared with Schaedler agar and enriched with 5% sheep blood.3 These media were kept at least 72 hours at 37°C on anaerobic jars (Oxoid USA, Inc., Columbia, MD). The anaerobic atmosphere was obtained by Gas-Pack (Oxoid USA,
**TABLE 1. Technical Data of Focus NIGHT & DAY Lenses**

<table>
<thead>
<tr>
<th>Material</th>
<th>Lotrafilcon A Fluorosilicone Hydrogel Group I (FDA) nionic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dk</td>
<td>40</td>
</tr>
<tr>
<td>Dk/t</td>
<td>175 \times 10^6 at -3.00 D</td>
</tr>
<tr>
<td>Water content</td>
<td>24%</td>
</tr>
<tr>
<td>Refractive index</td>
<td>1.42</td>
</tr>
<tr>
<td>Lens radius</td>
<td>8.40, 8.60</td>
</tr>
<tr>
<td>Total diameter</td>
<td>13.80 mm</td>
</tr>
<tr>
<td>Center thickness</td>
<td>0.08 mm at -3.00 D</td>
</tr>
<tr>
<td>Power range</td>
<td>-0.25 to -10.00 D</td>
</tr>
<tr>
<td></td>
<td>+0.25 to +6.00 D</td>
</tr>
</tbody>
</table>

Inc., Mitsubishi Gas Chemical Company, Inc.). After this incubation period, gram stains were prepared from every colony with a different appearance and were described and subcultured. The aerobic or aerotolerant character of these colonies was noted. The identification of anaerobic bacteria was made by API 20 A (BioMérieux). For the isolation of fungi, inoculation was made from the transport media to Sabouraud's dextrose agar and was incubated for 1 week at 25°C.3,4

The McNemar test was used for statistical analysis to determine the difference in the presence of coagulase-negative staphylococci, diphtheroid rods, and Propionibacterium acnes before and after lens wear. A Fisher exact test was used for the statistical analysis of the presence of Fusobacterium nucleatum because this species was not isolated before lens wear.

**RESULTS**

Cultures of 29 eyes were compared before and after lens wear (Table 2). Before lens wear 19 (65.52%) of 29 eyes had negative bacterial cultures and 10 (34.48%) of 29 eyes had positive bacterial cultures. After using 30-day continuous-wear lenses, 3 (10.34%) of 29 eyes had negative bacterial cultures (P = 0.0005) and 26 (89.66%) of 29 eyes had positive bacterial cultures (P = 0.0005).

Four different species of bacteria were isolated from the eye smears cultured during the study (Table 3): coagulase-negative staphylococci, diphtheroid rods, *P. acnes*, and *F. nucleatum*. However, *F. nucleatum* was not detected before lens wear. It was also seen that the number of eyes with a growth of coagulase-negative staphylococci and diphtheroid rods in conjunctival cultures significantly increased after using these lenses (P = 0.001 and P = 0.031, respectively). Statistically, no significant difference was found in the number of eyes that carried *P. acnes* and *F. nucleatum* in their conjunctival cultures before and after the use of these lenses (P = 0.998 and P = 0.488, respectively).

**DISCUSSION**

A healthy eye maintains a natural microbiologic flora during its entire lifetime. The external eye has indigenous flora composed primarily of gram-positive organisms. This normal flora consists largely of *S. epidermidis* and diphtheroid rods, although other organisms, such as anaerobes and fungi, can be isolated in small numbers.1,2 In a case study of asymptomatic soft contact lens wearers, contamination was found to be as high as 70% in their lens care systems, 57% in their lens storage containers, and 17% in their conjunctiva.3 Another study showed that no significant differences were seen between the conjunctival flora and the posterior-side flora of the lenses, with *S. epidermidis* being the most frequently isolated organism.4 It was also shown that normal conjunctival flora was not changed by the frequent replacement of daily-wear soft contact lenses, but there was a nonsignificant increase in the bacterial population. Again, *S. epidermidis* was the predominant organism found in the conjunctival samples of the aforementioned users.5

Coagulase-negative staphylococci and diphtheroid rods are normal inhabitants of the outer surface of the human eye. These microorganisms serve as part of the defense mechanism of the ocular anatomy in preventing colonization and infection by pathogenic bacteria.6 An initial concern about contact lenses was the potential effect of lenses wear on the normal microbiota of the eye.7 Several investigations have indicated that major changes in the microbiota do not occur with contact lens wear.8,9 The advent of extended-wear contact lenses reduced the frequency of use of solutions and cases. Reduced manipulation of the lenses and potentially contaminated solutions, therefore, should also reduce the incidence of contamination.10 Another study showed that although hand contact was a major source of microbial contamination of a contact lens, the hand-transported microorganisms do not usually survive permanently on the lens of a healthy eye. Improperly kept lenses showed pathogenic microbial associations.11 Elander et al.12 suggested that lenses worn on an extended-wear basis for 1 week showed a trend toward a higher colonization rate (61%) than did daily-wear lenses (42%), but the difference was not statistically significant. Keay and Wilcox13 compared the bacterial colonization of a high-Dk silicone hydrogel contact lens worn on a 30-night extended-wear basis to that of a low-Dk hydroxyethyl methacrylate-based lens worn on a 6-night extended-wear schedule. They found no difference between the low- and high-Dk soft contact lens groups in the proportion of contact lens colonized by *Propionibacterium* species (48% vs. 43%, P = 0.4) or coagulase-negative staphylococci (47% vs. 54%, P = 0.2). In the current study, coagulase-negative staphylococci were the predominant organisms and diphtheroid rods were the dominant ones found in the conjunctival samples before and after lens wear, respectively. It was detected that there was a statistically significant difference between the number of eyes containing these microorganisms before and after lens wear, respectively.

**TABLE 2. Culture Results of the Inferior Cu/le-de-sac**

<table>
<thead>
<tr>
<th>Culture</th>
<th>Before lens wear (n = 29)</th>
<th>After 30 days of continuous lens wear (n = 29)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>19 (65.52%)</td>
<td>3 (10.34%)</td>
<td>0.0005</td>
</tr>
<tr>
<td>Positive</td>
<td>10 (34.48%)</td>
<td>26 (89.66%)</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

**TABLE 3. Bacteria Isolated From the Inferior Cul-de-sac and Statistical Analysis**

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>No. of eyes (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulase-negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>staphylococci</td>
<td>8 (27.59)</td>
<td></td>
</tr>
<tr>
<td>Diphtheroid rods</td>
<td>4 (13.80)</td>
<td>0.08</td>
</tr>
<tr>
<td>Propionibacterium acnes</td>
<td>3 (10.34)</td>
<td>0.031</td>
</tr>
<tr>
<td>Fusobacterium nucleatum</td>
<td></td>
<td>0.488</td>
</tr>
</tbody>
</table>

**Fisher exact test.**

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bacteria before and after lens wear \( (P = 0.001 \text{ and } P = 0.031, \text{ respectively}). \)

The number of eyes containing \( P. \text{acnes} \) was the same before and after lens wear. \( F. \text{nucleatum} \) was not found in the eyes before lens wear, but it was detected in three eyes after lens wear. This result was not a significant difference.

The patients did not use any lens disinfection solutions because they replaced their new high-Dk silicone soft contact lenses with a new one after the 30 days of continuous wear. Therefore, there was no hand contact with the lens during the 30 days of continuous lens wear.

In the study group, the number of bacterial species isolated from the eyes before lens wear was smaller than the number of bacterial species isolated after lens wear. Coagulase-negative staphylococci, diphtheroid rods, and \( P. \text{acnes} \) were the predominant bacteria of the eyelids and conjunctival flora. In this situation, the presence of these bacteria isolated in the study group was accepted as nonpathogenic microorganisms. \( F. \text{nucleatum} \), which is an anaerobic bacteria of the respiratory tract flora, could also be accepted as a nonpathogenic microorganism. Therefore, colonization by these bacteria may be the result of contamination.

In conclusion, the results of this study suggest that the sterility of conjunctival flora after using 30-day continuous-wear silicone hydrogel contact lenses significantly decreased and that the number of normal conjunctival flora significantly increased after the use of these lenses. Contamination by the bacteria from the eyelids may be a possible colonization factor in this study group. Therefore, it is appropriate to examine the patients who wear these lenses more frequently.

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