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Review

The association between contact lens use and microbial keratitis during the COVID-19 pandemic: a review

Shan-Chih Lee[1], Shih-Chien Huang[1], Connie Chen[3,4*]

[1] *Department of medical imaging and radiological sciences, Chung Shan Medical University, Taichung City, Taiwan*
[2] *Department of Nutrition, Chung Shan Medical University, Taichung City, Taiwan*
[3] *Department of Optometry, Chung Shan Medical University, Taichung City, Taiwan*
[4] *Institute of Optometry, Chung Shan Medical University, Taichung City, Taiwan*

Purpose: Coronavirus disease 2019 (COVID-19) remains a worldwide threat by causing various respiratory, gastrointestinal, liver, neurological diseases, and eye infections. Rigid gas-permeable (RGP) and soft contact lenses should be adequately stored and sterilized by soaking them in a solution for 6-8 hours daily. Bacterial contamination can lead to microbial keratitis (MK) or contact lens-induced acute red eye (CLARE) when improperly sterilized contact lenses are worn for extended periods. This review aimed to determine the association between contact lens use and MK during the COVID-19 pandemic.

Methods: Reviewed the association between COVID-19 and contact lenses based on literature published in 2022. In addition, each search was adjusted for the following keywords used in various combinations: "coronavirus" and "contact lenses," COVID-19 and eyes", and "contact lenses and COVID-19". These search terms were applied to two databases: PubMed and Google scholar.

Results: MK was a devastating ocular complication associated with inappropriate contact lens use (prevalence,.2-6.9% per 10,000 wearers). Lens cases were the most contaminated item (62%), followed by lenses (56%), solution bottles (48%), and lens care solutions (42%). Furthermore, people who occasionally wore contact lenses showed a higher infection rate than those who wore them regularly.

Conclusion: COVID-19 may be acquired through the conjunctiva. Therefore, practitioners must remain vigilant, remind contact lens wearers to practice proper hygiene and handling of contact lenses, and follow all precautions while directly touching the eye at all times.

Keywords: contact lens, microbial keratitis, COVID-19, eye disease, contact lens solution

1. Introduction

The novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in Wuhan, China, in December 2019 and has since infected more than 630 million people worldwide, killing an estimated 6.59 million people. In addition to the primary respiratory symptoms, such as hoarseness and pneumonia, it can also cause meningitis (1). The first person to warn about coronavirus spread in China was Dr. Li Wenliang, an ophthalmologist. It is generally believed that he was diagnosed and treated as an asymptomatic glaucoma patient who contracted and died of COVID-19. All coronaviruses that have caused human diseases have had animal origins, generally in bats or rodents.(2) and may therefore be responsible for potential viral ocular

* Corresponding Author: Connie Chen
Address: No. 110, Sec. 1, Jianguo N. Rd., Taichung City, 40201, Taiwan
Tel: +886-4-24730022 ext 12007
E-mail: cconnie7@gmail.com

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infections. Contact lens use has drastically risen with the increasing global myopia, especially in Asia. As a result, the prevalence of contact lens-related infection has also increased (3). With technological advancements, contact lenses are now more versatile, available as non-disposable contact lenses, such as rigid gas-permeable lenses (RGPs) which need to be disinfected in a storage case before use (4). Improper cleaning of contact lenses may cause microbial keratitis (MK) due to bacterial or infectious keratitis. MK is associated with contact lens use and, if not treated immediately, may lead to permanent vision impairment (5). However, reusable lenses, whether RGPs or soft contact lenses, require a storage case to store and disinfect lenses, and need approximately 6 to 8 hours of daily cleaning time. Thus, cleaning in storage cases should be a mandatory daily routine for users. Otherwise, the lenses may get contaminated by microorganisms while everyday handling (6, 7). Regular use of improperly disinfected contact lenses, could lead to bacterial contamination of the lenses and thereby development of microbial keratitis (MK) or contact lens-induced acute red eye (CLARE) (8).

2. Methods

We reviewed the association between COVID-19 and contact lenses based on literature published in 2022. Each search was adjusted for the following keywords used in various combinations: "coronavirus" and "contact lenses," COVID-19 and eyes", and "contact lenses and COVID-19". These search terms were applied to two databases: PubMed and Google scholar. This search strategy was used to obtain the titles and abstracts of relevant studies in any language, with an all-author search in the first stage. In the second stage of the investigation, the full text of the article was reviewed to determine if the tip was appropriate. All authors were screened according to the following inclusion criteria: (1) clinical studies and (2) the association of COVID-19 with contact lenses. We excluded the following: (1) papers investigating ocular manifestations in vitro and (2) studies without a complete clinical picture of developing COVID-19 or coronavirus confirmation following the current guidelines. All authors collaborated on data extraction for further analysis and expressing the relevant data.

3. Results

To prevent infection, first, safe social distancing should be observed even during hospital visits, by incorporating non-contact tonometry, automated perimetry, and eye drops. Second, patient visits must be reduced, and all non-urgent appointments rescheduled. Protective measures for practitioners should include: wearing a surgical mask and installing a protective cover over the slit lamp, and avoiding contact with the face, nose, mouth, and eyes. In terms of diagnosis, in addition to taking an ocular history, include detailed and accurate TOCC (travel history, occupation, contact History, cluster), in addition to the onset time, duration, and characteristics of the symptoms.

Overview of microbial keratitis

Sight-threatening diseases like MK are devastating ocular complications related to improper use of contact lenses (9). It is mostly observed in the corneal epithelium, determined by the type and virulence of the microorganism(s) involved, and depend on patient's contact lens use habits. In the non-disposable contact lens wearer population, the prevalence of MK varies from 2.2 to 6.9 per 10,000 wearers (8, 10).

Contact lens usage and the storage case

Especially in Asia, a combination of genetic predisposition and changes in lifestyle has led to a rapid increase in the myopia population. For instance, research in Singapore indicates that, in males aged 15-25 years, myopia prevalence has increased from 26% in the late 1970s to 83% in the late 1990s (11, 12). Another study from Taiwan also indicated that the myopia population in school children has increased from 20% at 7 years old to 61% at 12 years old, followed by 81% at 15 years old (13). This may be caused by reduced outdoor activities, added time for near-distance activities, or other unclear factors.

With an increasing myopia population globally, especially in Asia, the use of contact lenses has also increased. Therefore, optometrists must ensure the wearer's good hygiene practices and cleanliness habits.

Microbial contamination

A previous study regarding microbial contamination

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and contact lens care in India had enrolled medical and dental students as the subjects. Thirty-seven participants (74%) showed microbial growth in at least one sample. The overall rate of microbial contamination in the total sample was 52% (104/200). Lens cases were the most contaminated samples (62%), followed by lenses (56%), solution bottle tips (48%), and lens care solutions (42%) (5).

Another previous study found that 66% of lens cases were contaminated belonging to participants aged between 18-69 years. 37% of the contaminated storage cases had multiple microorganisms, with the maximum co-contamination by six species, Bacillus spp., S. viridans, D. acidovorans, S. maltophilia, Propionibacterium spp., and fungi. Participants who regurlarly washed their hands with soap and water had significantly lower contamination levels in a mirror box than those who did not or only used tap water (P=0.005). The more the years of wearing experience, the higher the contamination rate. As the storage case is often damp, participants are vulnerable to contamination (14). A research carried out in Hong Kong reported that 9% of lens extracts, 34% of case extracts, and 11% of all tested solution samples were contaminated with ocular pathogenic microorganisms. Serratia spp., Staphylococcus aureus, and coagulase-negative staphylococci were the most frequently isolated microorganisms. They also found that occasional contact lens wearers had a higher contamination rate than regular wearers. Rinsing the contact lens with normal saline or a multifunctional solution before putting it on, effectively reduced contamination (15). Biofilms formed by the *S. aureus* isolate were less denser but more resistant to hygiene procedures than those of the P. aeruginosa isolate. Rinsing (with Contact lens Multi-Purpose Solution or hot water) followed by 6 hr of air-drying was insufficient to remove these heavy biofilms. Furthermore, rinsing with MPS, followed by tissue wiping and air drying, used to be the most effective practice for decontamination by both the strains (16). After MPS disinfected the contact lens case, drying up to 3 h in a warming device showed the removal of Staphylococcus aureus and Pseudomonas species that had been formed biofilms in the wells of the case.(17).

Infection prevention in the practice

Firstly regarding good hygienic practice, we must obey safe social distancing, outdoors as well as indoors (18). Crowded areas in the clinic should be consistently cleaned and sterilized. This is especially important for high-touch areas, such as spectacle and trial frames, trial lenses, chin tests, and headrests, which are the most common testing necessities. The practitioner and staff should not attend work if they do not feel well (19). If a procedure is not critical, such as non-contact tonometry, automated visual field perimetry, or eye drops, it should be avoided.

Secondly, patient visits must be reduced, and all non-urgent appointments should be rescheduled. Before the position, the practitioner should ask about the patient's travel history, occupation, contact, and cluster. Ophthalmologists and optometrist's precautionary measures should consist of: surgical masks, installing protective shields on slit lamps, and avoiding touching the face, nose, mouth, and eyes (20).

4. Conclusion

4.1 Prevalence of Suicide Attempts

Contact lens hygiene has long been a key preventive measure for contact lens-related infection and inflammation. However, microbial keratitis (MK) was the only severe and potentially vision-threatening contact lens adverse event. International research, including a recent study in the Asia-Pacific region, shows that although MK is rare, owing to severity of the consequences, it is essential to minimize risk factors. Research shows that one of the key risk factors is improper hygiene of lenses and lens cases. Therefore, it is also helpful to review the patient-behavior to gain insight into their hygiene habits. Recent studies have shown that patients' lens care habits must be revised to the required standards (21). Poor hand hygiene is a known risk factor for developing MK (22). Compared with other parts of the body, the bacterial diversity of the hands is greater and more active. It is strongly influenced by gender, environment, and hand washing (23). After hand washing, although there is a decrease in bacterial number, their diversity was preserved , Although diversity on palm surfaces is high at both the phylotype and species levels (sequences from >25 phyla were detected), 3 varieties (Actinobacteria, Firmicutes, and Proteobacteria) accounted for 94% of the series.

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The most abundant genera (Propionibacterium, 31.6% of all sequences; Streptococcus, 17.2%; Staphylococcus, 8.3%; Corynebacterium, 4.3%; and Lactobacillus, 3.1%) were found on nearly all palm surfaces sampled. (23). Because bacteria have inherently different transmission potentials, handwashing may have differential effect on preventing the transmission of other species (24). Thus, the microbiological findings of this study may have been influenced by the increased frequency of hand washing and campaigns advising against excessive hand-face contact during the pandemic, which may have altered the autoinoculation of pathogenic microorganisms on the ocular surface.

Since the tear film on the ocular surface adopts a variety of host defense mechanisms to reduce the chances of infection of the conjunctiva and cornea, which are devoid of receptors (ACE2) for the entry of new coronavirus into the host cell, the virus cannot easily replicate in the conjunctiva, hence, many medical journals mention only a minimal number of patients affected with new coronary pneumonia as having symptoms of conjunctivitis. The US Centers for Disease Control (CDC) also released no evidence of contact lens wearers being more prone to new coronary pneumonia infection as compared to spectacle wearers, and moreover, framed glasses are not considered as sufficient eye protective gear. Thus, the eyes are not the preferred route of entry of COVID-19, and the risk of COVID-19 transmission through teardrops is low.

Regardless of use of eyeglasses or contact lenses, COVID-19 may be avoided by not touching the eyes, mouth, and nose and improving personal hygiene habits.

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Competing interests

The authors declare that they have no competing interests.

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