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Research Article

Slit Lamp Barrier Shield as a Means of Protection against Respiratory Droplets

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Abstract

Purpose: The general arrangement of slit lamp biomicroscopy requires close proximity of the patient and physician, which raises the risk of respiratory droplet exposure to both parties. Here we propose the use of protective plastic barrier shield as a means of preventing respiratory droplet exposure during ophthalmic examination with a slit lamp.

Methods: Detailed measurements are taken of the Haag-Streit slit lamp instrument and an electronic die cutting machine is used to create openings for the biomicroscope oculars from clear sheets of plastic (0.020 thickness × 8.5 - 9 width × 11 - 11.5 height inches). Once the plastic barrier sheet shield is placed onto the slit lamp binoculars, a spray bottle containing a fluorescein solution is used to spray from the chin rest towards the examiner while a sheet of paper with an examiner's image is positioned on the examiner's side. This spray simulates the respiratory droplet exposure to health care personnel from infectious patients. Spraying the fluorescein solution is performed with and without the presence of the protective plastic barrier shield, after which the amount of fluorescein staining on the paper face model is assessed using Wood's lamp.

Results: Placement of a slit lamp barrier shield markedly reduces the amount of exposure from respiratory droplets between patients and examiners. This set up is also applicable to other commonly-used ophthalmic devices such as optical coherence tomography (OCT) machine and could potentially help in preventing the spread of COVID-19 and other airborne infectious agents among ophthalmic personnel and their patients.

Conclusion: Considering the effectiveness of slit lamp shield in containing the spread of aerosolized droplets, the inclusion of these protective barriers, particularly in the advent of COVID-19 pandemic, is highly recommended.

Keywords: *COVID-19; Coronavirus; Droplet; Airborne; Aerosol; Transmisión; Slit Lamp; Optical Coherence Tomography; OCT; Shield; Barrier*

Introduction

Airborne transmission of different infectious agents including viruses has recently gained significant attention due to the advent of coronavirus or COVID-19. In particular, viral load in throat swabs reach their highest level at the time of symptom onset [1], as a consequence of which the risk of interhuman transmission increases via the spread of saliva droplets by coughing or sneezing [2]. There are three major possible transmission routes known to exist for communicable respiratory infections, namely the long-range airborne route, the close contact route, and the fomite route [3]. Close contact is usually defined as being within 3 feet (~1 meter) of the infector, which is of particular concern to ophthalmologists due to the close proximity of patients' and examiners' faces during the ocular examination. For the same reason, the American Academy of Ophthalmology (AAO) is imposing new recommendations to prevent the spread of this virus. More specifically and for the slit lamp examination, the AAO suggested guidelines are to place a plastic breath shield on the slit lamp biomicroscope and/or to wear a mask with a plastic eye-covering [4]. In this article, we are testing a newly-developed slit lamp shield to determine its impact on the spread of aerosolized droplets.

Methods

Detailed measurements are taken of the Haag-Streit slit lamp instrument, and thin plastic sheets are used to make a prototype to confirm dimensions and placement of the openings for the oculars. Once measurements are confirmed and adjusted on the prototype, an electronic cutting machine is used to create the openings for the slit lamp biomicroscope ocular parts, using thicker plastic sheets. For the final product, transparent sheets of 0.020 thickness × 8.5 - 9 width × 11 - 11.5 height inches (Figure 1A) are used to create the slit lamp barrier shield, using the preset settings on the electronic cutting machine.

For the simulation of a cough, sneeze, or talk scenario and to track the spread of droplets, a spray bottle is filled with a dilute fluorescein solution, which is made by placing a few drops of ophthalmic fluorescein solution into one liter of water. Afterward, the bottle tip is placed at the chinrest of the slit lamp at the approximate height of patient's mouth and sprayed towards the side of the examiner. On the examiner's side, a paper with the examiner's face image is placed appropriately in order to track the location of sprayed droplets using a Wood's lamp. More specifically, the dimensions of the face print-out matched the size of a human subject and while placing the print-out on the examiner's side, it was ensured that the oculars and the paper model eyes were both at the same level (Figure 2A). Figures 2B and 2C demonstrate the extent of droplet exposure over the examiner's face in the absence and presence of a shield, respectively. A similar outcome is obtained when the fluorescein is sprayed from the examiner's side towards the patient, where the extent of droplet exposure on the face model was markedly reduced with the barrier shield in place (images not shown).

Results and Discussion

The spread of COVID-19 droplets, particularly in symptomatic individuals with high viral loads in their throats [1], is concerning for the transmission of this disease from patient to physician and vice versa. Therefore, while encouraging social distancing as well as hand hygiene, it is recommended to cover the mouth during coughing and/or sneezing to reduce the spread of respiratory droplets [2]. Here we demonstrate that by placement of a slit lamp shield (Figure 1B and 1C), the extent of the spread of simulated respiratory droplets is significantly reduced from patient to physician (Figure 2) and vice versa. Figure 2B demonstrates the spread of aerosolized droplets in the absence of our proposed shield model. The experiment is carried out with the original breath barrier that is normally supplied with the Haag-Streit slit-lamp machine. Nevertheless, this small shield is not enough to protect from the spread of droplets in the forehead and cheek area of the face, indicating that the width and height of the breath shield should be more substantial. Under these circumstances, placement of an additional barrier shield with proper dimensions can help prevent the spread of aerosolized droplets.

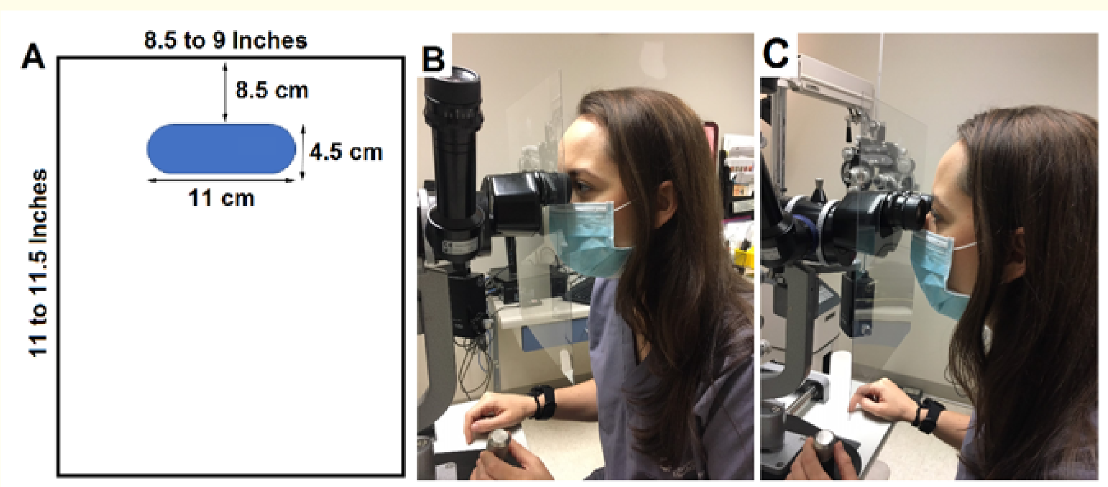

Figure 1: *Dimensions (panel A) and set up of (panels B and C) of a barrier shield on the slit lamp.*

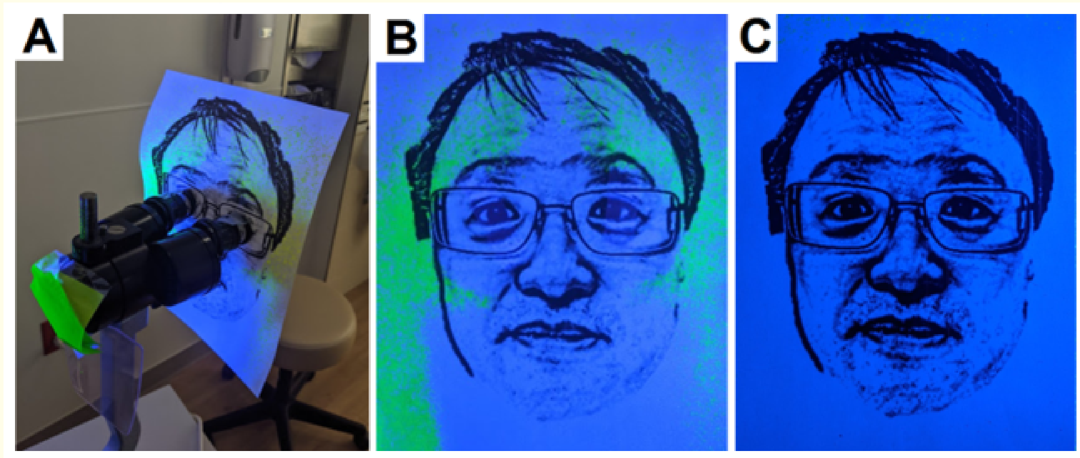

Figure 2: *Experimental set up (panel A) for determining the extent of droplet deposition after spraying fluorescein solution towards the examiner in the absence (panel B) or presence (panel C) of a slit lamp shield, as visualized by the Wood's lamp.*

A similar protective barrier can also be applied to other ophthalmic devices including the portable slit lamp, optical coherence tomography (OCT), and indirect ophthalmoscope, as illustrated in figure 3.

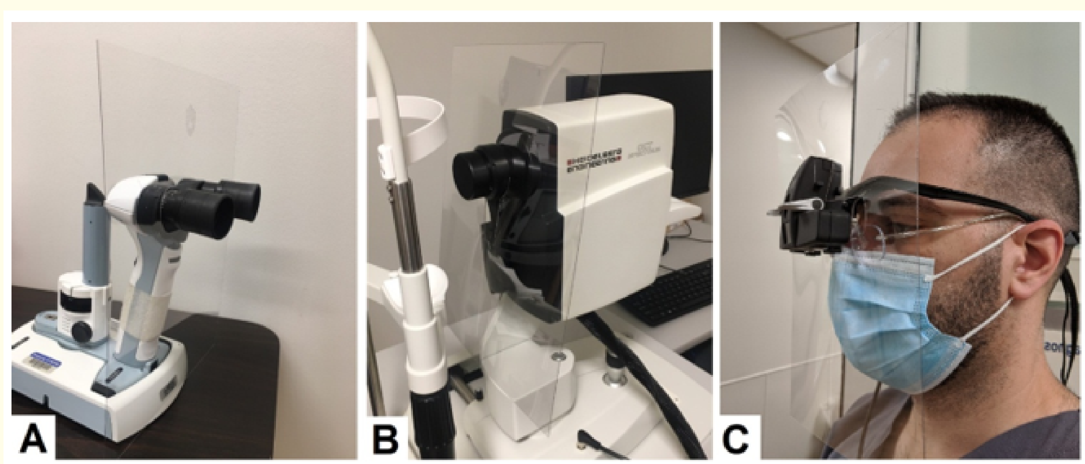

Figure 3: *Set up of a barrier shield on portable slit lamp (panel A), optical coherence tomography machine (panel B), and indirect ophthalmoscope (panel C).*

Conclusion

Considering the relatively cheap and easy task of creating a slit lamp shield along with its effectiveness in containing the spread of aerosolized droplets, the inclusion of these protective barriers, particularly in the advent of COVID-19 pandemic, is highly recommended.

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All authors consent to publishing participant images included in this article.

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