Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

HUMAN SUBJECTS: Human subjects were included in this study. The human ethics committees at Vanderbilt University Medical Center approved the study. All research adhered to the tenets of the Declaration of Helsinki. All participants provided informed consent.

No animal subjects were included in this study.

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Do Slit-Lamp Shields and Face Masks Protect Ophthalmologists amidst COVID-19?

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is transmitted primarily via respiratory droplets, contact with contaminated surfaces, or free-floating aerosols.[1,2] The American Academy of Ophthalmology recommends the use of surgical masks and commercially available slit-lamp shields (Breath Shields; Carl Zeiss AG, Oberkochen, Germany).[3] However, a lack of evidence exists regarding the true efficacy of slit-lamp shields. We attempted to replicate the spread of infected aerosols and large droplets in the clinical setting of a slit-lamp examination to evaluate the efficacy of protective equipment in reducing the risk of viral transmission.

This study adhered to the Declaration of Helsinki and institutional review board approval was not required. Aerosols were defined as smaller light particles that remain suspended in the air because of slowly settling velocity, whereas large droplets were defined as heavier particles that fall rapidly after a downward trajectory.[4] The experimental setup (Fig S1, available at www.aaojournal.org) consisted of a slit lamp (B900 Slit Lamp; Haag-Streit Holding AG, Köniz, Switzerland), a mannequin face that represented the ophthalmologist, and a spray bottle at the chin rest that represented respiratory particle production from the patient. A particle produced by the spray bottle had a peak velocity of 4.0 meters/second and a maximum horizontal distance of 2.35 m, which was comparable to particle behavior by coughing or sneezing. A high-speed camera capturing 1000 frames/second (Chronis 1.4; Kron Technologies, Inc., Burnaby, Canada) was used for video recordings (Fig 1). This process was repeated for 3 simulations: (1) no protective equipment; (2) commercially available slit-lamp breath shield installed; and (3) mask placed in front of the spray bottle (Fig S1). For simulation 3, 5 types of masks were used: an N95 respirator (N95 particulate respiratory 8210; 3M, Alexandria, MN), 3 surgical masks of different brands and bacterial filtration efficiencies ranging from 95% to 99%, and a cloth mask (bacterial filtration efficiency, 55%).

The outcome measure for aerosol transmission was the number of aerosol particles in a predefined region (Fig 1, rectangle area bordered in red [31.2 × 19.6 mm]). In total, we included 26 consecutive frames (6 ms apart) from the video recordings of each simulation. Two trained graders (Y.J.X., T.T.Y.F.) independently counted the number of aerosol particles within this region, with the mean of the 2 used as the final count. A 1-way analysis of covariance test was used to compare the number of particles in this region for each simulation. To determine the risk of large droplet transmission, identical simulations were repeated with Glo Germ liquid (Glo Germ Company, Moab, UT). The slit lamp, table, and mannequin were examined under ultraviolet A light for fluorescent droplets.

In simulation 1 (Fig 1A), aerosols remained suspended in the air, with the highest density anterior to the mannequin's mouth and nose. This density was reduced in simulation 2 (Fig 1B). In simulation 3 (Fig 1C), no particles could be observed for all 5 types of masks. The mean ± standard deviation number of particles in the region of interest was 42.7 ± 34.5 for simulation 1, 12.3 ± 5.7 for simulation 2, and 0.0 ± 0.0 for simulation 3 ($P < 0.001$; Fig S2, available at www.aaojournal.org). Post hoc analysis showed that simulation 3 had a statistically significantly lower aerosol count than simulation 2, which in turn had a lower aerosol count than simulation 1 ($P < 0.05$). Hyperfluorescent areas were found on the lower half of the mannequin, slit lamp, and table for simulation 1. In simulation 2, hyperfluorescent areas were seen on the mannequin's neck, the shield, the slit lamp, and the table. In simulation 3, the hyperfluorescent area was observed only on the inner surface of the masks (Fig 1).

The close proximity between the ophthalmologist and the patient increases risk of respiratory transmission of virus.[4] With or without the slit-lamp shield, aerosols congregated at the highest density in the region of the ophthalmologist's nose and mouth. Because SARS-CoV-2 remains viable in aerosols for hours,[2] a high concentration

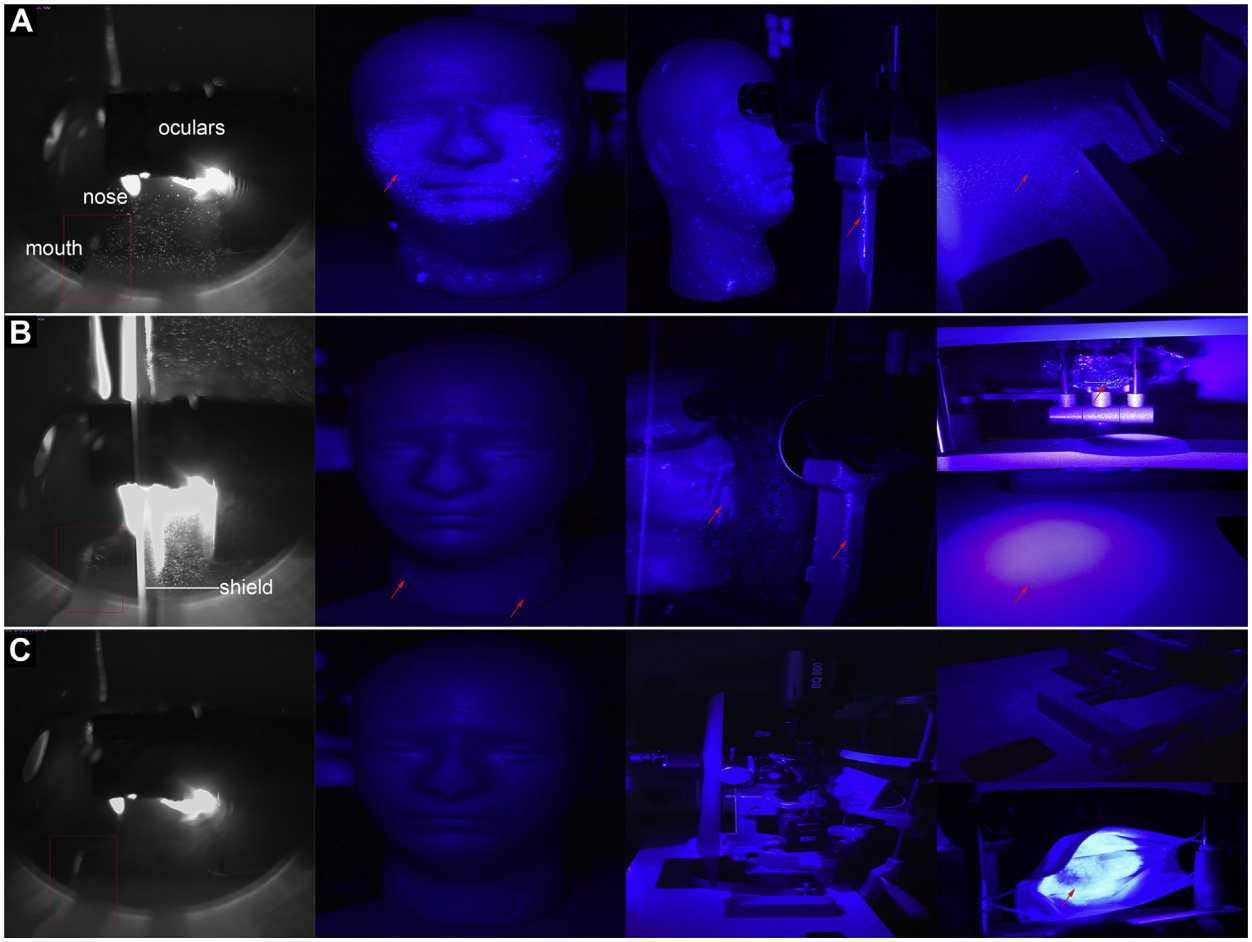

Figure 1. Each row of pictures labeled (**A**), (**B**), and (**C**) represents the described simulations 1, 2, and 3, respectively. The first column shows selected freeze frames with the highest aerosol count from each simulation's video recording. The positions of the oculars of the slit lamp, slit-lamp shield, mannequin's nose, and mouth are labeled for reference. The rectangular area bordered by red represents the region of interest, with a standardized area used for manual counting of aerosol particle numbers. The subsequent 3 columns depict examination of the mannequin, slit-lamp apparatus, and table under ultraviolet A light. Red arrows indicate areas of hyperfluorescence. In simulation 1, hyperfluorescent areas were visualized on the mannequin, slit lamp, and table. In simulation 2, hyperfluorescent areas were not visualized on the mannequin's face but were present on its neck, the slit-lamp apparatus and shield, and the table. In simulation 3, hyperfluorescent areas were not visualized on the mannequin, slit lamp, shield, or table, but were present on the inner surface of the face mask.

of aerosols poses an inhalation threat to ophthalmologists. Although slit-lamp shields reduced the risk of large-droplet transmission, they were limited in protection against infectious aerosols that were present on the side of the shield facing the mannequin (Fig 1B). This could be because of minor leaks at the oculars of the slit lamp where the shield is attached. Studies have demonstrated a lower efficacy of face shields against smaller aerosols because they can travel around the face shields.[5] When using a slit-lamp shield alone, the slit lamp, shield, and table can act as fomites for contact transmission; proper disinfection practices are needed because SARS-CoV-2 has surface stability for up to 72 hours.[2]

Our study showed that all 5 types of face masks on patients provided the most complete protection against aerosol and droplet transmission. This could be explained because bacterial filtration efficiency was a measurement of particles filtered out at a pore size of 1.0 to 5.0 μm, which was too small to be detected by the camera. Ma et al[6] demonstrated that surgical masks can block up to 97% of SARS-CoV-2 via aerosol transmission. However, some studies involving human participants demonstrated poor efficacy of face masks, which could be attributed to poor facial fit, leading to leakage of infectious particles. In our study, the mask provided complete coverage over the small spray nozzle, which could have accounted for a better level of protection.

Limitations included technological constraints of the camera, which might have missed smaller aerosol particles. Statistical significance in reduction referred exclusively to count consistency and was not a direct estimate of reduced infection risk. The use of a spray bottle to simulate droplet or aerosol production from the patient cannot exactly replicate the actions of coughing or sneezing. Further studies are needed to interrogate the efficacy of shields and masks against viable SARS-CoV-2 in respiratory particles exceeding the minimal infectious dose. These ideally should be examined with a validated cough aerosol simulator.

In conclusion, slit-lamp shields provide added protection for ophthalmologists but should be used together with other forms of

personal protective equipment. All patients should wear face masks because of their efficacy in reducing aerosol and droplet transmission.

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Refractive Outcomes of the Yamane Flanged Intrascleral Haptic Fixation Technique

Scleral fixation of a posterior chamber intraocular lens (IOL) is an established surgical approach in cases where capsular support has been lost.[1] It represents an alternative to angle-supported or iris-fixated anterior chamber IOLs and may mitigate some of their associated complications.[1−4] Recently, a sutureless fixation technique was described in which haptics of a 3-piece IOL were externalized through scleral tunnels and secured by melting the haptic tips into a flange using a low-temperature cautery probe.[1] The flanges become wedged in the tunnel, resulting in scleral fixation. This flanged intrascleral haptic fixation technique (FIHFT) may be faster than other scleral fixation methods and has demonstrated an acceptable safety profile.[1] Currently, limited knowledge exists on FIHFT refractive outcomes and few comparative data with anterior chamber IOLs (ACIOLs). We therefore set out to assess refractive outcomes of the FIHFT in the setting of a tertiary eye hospital, multiple operating surgeons, and no patient exclusions with secondary analysis against ACIOL and routine in-the-bag cataract surgeries.

Data were collected retrospectively from a consecutive series of the first 115 patients undergoing FIHFT at the vitreoretinal unit of a tertiary eye hospital in Melbourne, Australia, between February 2017 and December 2018. Comparative data were collected from a series of consecutive and concurrent ACIOL insertion patients (n = 54) and routine phacoemulsification with in-the-bag IOL insertion patients (n = 100). Follow-up was for a minimum of 1 month within a period from December 2016 through December 2018. Human research and ethics committee approval was obtained (Royal Victorian Eye and Ear Hospital reference, 19/1409HQ), and research conducted according to the tenets of the Declaration of Helsinki, seventh revision. Informed consent was obtained from all patients. All patients underwent preoperative ocular biometry using an IOLMaster 500 or 700 (Carl Zeiss Meditec, Jena, Germany). Preoperative and postoperative ophthalmic assessments included visual acuity, subjective refraction, and slit-lamp biomicroscopy. In patients in whom corneal sutures were used, subjective refraction was performed at least 2 weeks after removal of sutures. A uniform surgical technique was used[1] that included a 25-gauge pars plana vitrectomy (Constellation Vision System; Alcon Laboratories, Inc., Duluth, GA). A 3-piece Abbott Medical Optics Tecnis ZA9003 IOL (Abbott Medical Optics, Santa Ana, CA) was inserted in all patients with an assumed in-the-bag position for the purpose of IOL power selection. Patients were reviewed routinely 1 day, 1 week, and 1 month after surgery. Longer follow-up was collected where possible.

The primary study outcome was subjective postoperative spherical equivalent (≥1 month after surgery or at the final appointment for which data were available) compared with the predicted refractive outcome calculated by the Barrett Universal II formula[5] using a lens factor of 1.94 for the Tecnis ZA9003 (per the manufacturer's recommended optical A-constant of 119.1).[6] The ACIOL lens in all cases was an Alcon Kelman Multiflex III MTA4UO (optical A-constant, 115.54). The IOLs used for in-the-bag cataract surgeries included the Alcon AcrySof IQ SN60WF (optical A-constant, 119.0), Abbott Medical Optics Tecnis ZCB00 (optical A-constant, 119.1), and Hoya