Science Foundation of China-General Programs (grant no.: 81770967, 81873675); National Natural Science Fund for Distinguished Young Scholars (grant no.: 81822010); the National Natural Science Foundation -Young Scientists Fund (grant no.: 81800810); and the Science and Technology Planning Projects of Guangdong Province (grant no.: 2018B010109008).

HUMAN SUBJECTS: Human subjects were included in this study. The human ethics committees at Zhongshan Ophthalmic Center, Sun Yat-sen University, approved the study. The requirement for informed consent was waived because of the retrospective nature of the study. All research adhered to the tenets of the Declaration of Helsinki.

No animal subjects were included in this study.

Author Contributions:
Conception and design: X.Wu, J.Chen, Yuan, Z.Liu, Yan, Sim
Analysis and interpretation: X.Wu, J.Chen, Yun, Yuan, M.Chen
Data collection: Hu, Z.Wu, Hu.Lin, Wang, Wu, M.Chen, C.Zhang, Zheng, X.Liu, Zhong, Li, J.Zhang, Cai, Lao
Obtained funding: N/A; Study was performed as part of regular employment duties at Guangdong Yun Hui Technology Co, Ltd; Vistel Visionary Intelligence Co, Ltd. No additional funding was provided.
Overall responsibility: X.Wu, J.Chen, Yun, Yuan,

Keywords:
COVID-19, Ophthalmic hospital, Virtual clinical service.

Correspondence:
Haotian Lin, MD, PhD, and Xiaofeng Lin, MD, PhD, Zhongshan Ophthalmic Center, Sun Yat-sen University, 54# Xianlie S. Road, Guangzhou 510060, China. E-mail: linht5@mail.sysu.edu.cn and linxiaof@mail.sysu.edu.cn.

## References

1. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet*. 2020;395(10223): 470–473.
2. Hollander JE, Carr BG. Virtually perfect? Telemedicine for Covid-19. *N Engl J Med*. 2020;382(18):1679–1681.
3. Ting DSW, Carin L, Dzau V, Wong TY. Digital technology and COVID-19. *Nat Med*. 2020;26(4):459–461.
4. Gunasekeran DV, Wong TY. Artificial intelligence in ophthalmology in 2020: a technology on the cusp for translation and implementation. *Asia Pac J Ophthalmol (Phila)*. 2020;9(2):61–66.
5. Radanović I, Likić R. Opportunities for use of blockchain technology in medicine. *Appl Health Econ Health Policy*. 2018;16(5):583–590.
6. Li W, Yang Y, Zhang K, et al. Dense anatomical annotation of slit-lamp images improves the performance of deep learning for the diagnosis of ophthalmic disorders. *Nat Biomed Eng*. 2020;4(8):767–777.
7. Kitazawa M, Sakamoto C, Yoshimura M, et al. The relationship of dry eye disease with depression and anxiety: a naturalistic observational study. *Transl Vis Sci Technol*. 2018;7(6):35.

## Spread of Respiratory Droplets in a Simulated Ophthalmic Surgery

Performing ophthalmic surgery safely during the coronavirus 2019 pandemic is important to ophthalmologists, anesthesiologists, nurses, patients, and health policy analysts. Although ophthalmic procedures themselves are not a major source of transmission,[1] the upper respiratory tract may harbor high concentrations of severe acute respiratory syndrome coronavirus 2.[2] Because concern exists that routine ophthalmic procedures may potentiate the spread of respiratory droplets onto operating room personnel, some centers mandate masks for all operative patients.[3] Herein, a series of simulations of a coughing patient during ophthalmic surgery were conducted to identify the potential spread of respiratory droplets and to evaluate interventions aimed at mitigating droplet spread from patients to operating room personnel. No human subjects were included in this study. Individual patient-level consent was not required.

In a series of simulations, a manikin was placed on a surgical bed in an operating room. For each simulation, a standard cataract surgical drape with a transparent adhesive quadrangle (level 4 eye surgical drape, 70 × 65 inches; Association for the Advancement of Medical Instrumentation PB70, MEDLINE) was placed over the surgical site, the adhesive drape was cut, and a speculum was inserted. The surgeon donned a clean surgical gown and gloves and sat with his hands adjacent to the surgical field (Fig 1A; Video 1, available at www.aaojournal.org). Three simulations were conducted as follows: (1) no surgical mask for the patient and a complete seal of the drape around the surgical field, (2) an ear loop surgical mask (American Society for Testing Materials level 2; 3M, Ontario, Canada) for the patient and an incomplete seal of the surgical drape intentionally applied by leaving a gap near the medial canthus, and (3) an ear loop surgical mask for the patient and a complete surgical seal with the adhesive of the drape. In scenarios 2 and 3, the superior edge of the mask was taped so that it adhered to the face. Methods previously validated for visualization of cough droplets were used[3–5] and are described in more detail elsewhere (Supplementary Appendix, available at www.aaojournal.org).

In the first simulation (no mask, complete seal), no visible droplet contamination of the surgical field or the surgeon was seen (Fig 1B). However, diffuse droplets appeared on the underside of the drape and on the manikin's body (Fig 2A, available at www.aaojournal.org). In the second simulation (mask, incomplete seal), droplets were seen on the surgical field (Fig 1C) and the surgeon's gloves, with minimal contamination of the underside of the drape. In the third simulation (mask, complete seal), no droplets were seen on the surgical field or the surgeon (Fig 1D), and minimal contamination occurred on the underside of the drape. During drape removal, droplets spread from beneath the mask onto the manikin's lower eyelid in all 3 simulations (Fig 2B, available at www.aaojournal.org).

These simulations demonstrate that a complete surgical seal and masked patient minimize droplet spread and that an incomplete seal may allow respiratory droplets to travel onto the surgical field. Incomplete seals are not uncommon, the reasons for which include a prominent nose, deep-set orbits, reflex blepharospasm, blepharitis, insufficient drying of the skin after prepping, progressive loss of the adhesion of the drape as the case progresses, or a combination thereof. In addition to drying the area adequately before application of the drape, a transparent adhesive film dressing can be used to reinforce adhesion of the draping further. An aerosol box[5] and additional plastic drapes[6] have been used in other medical disciplines to minimize risk of droplet spread during surgery, but these methods are not adapted as easily in ophthalmic surgery, where access to the eyes and adnexa in close proximity to the airways is required.

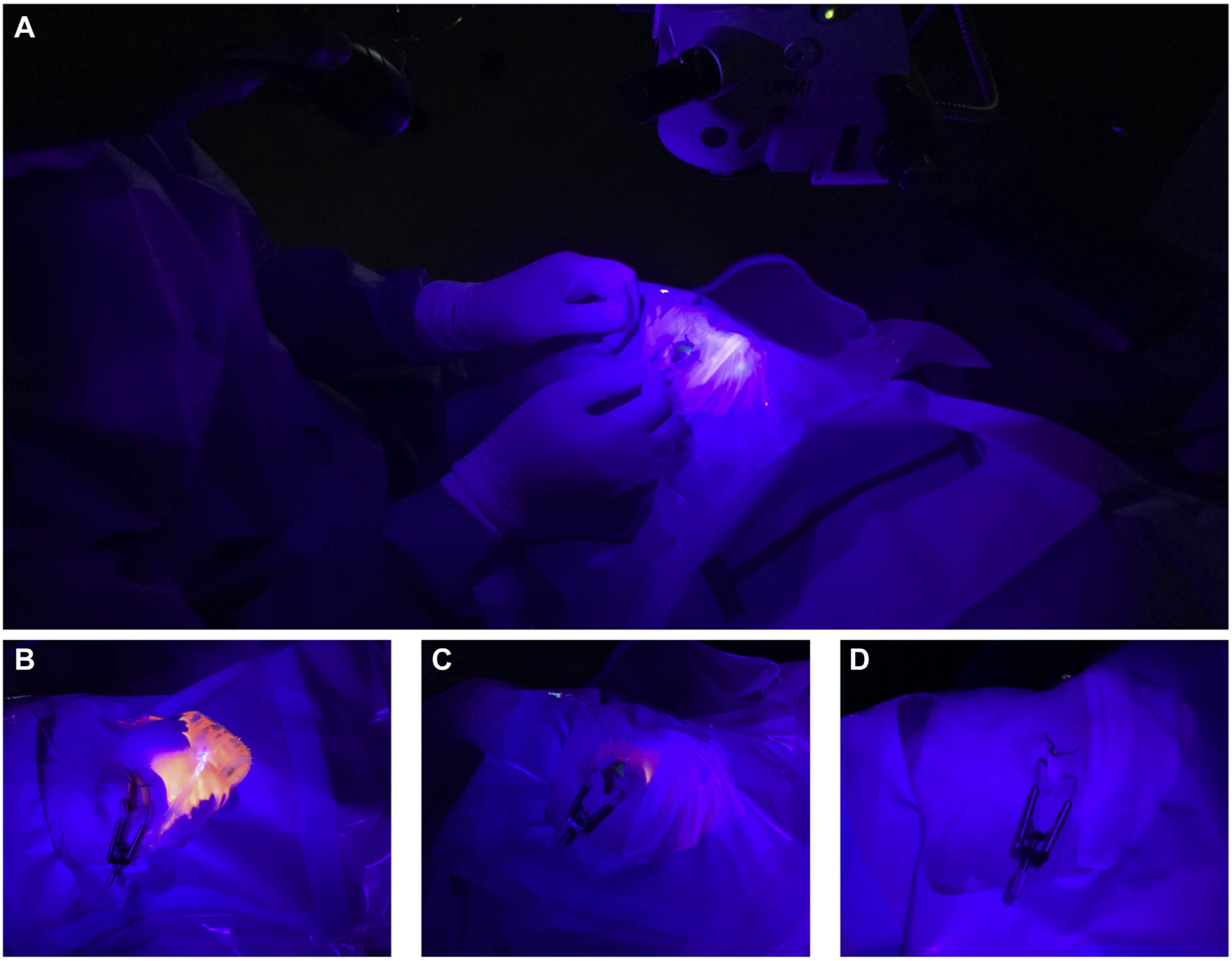


**Figure 1.** **A**, Simulation setup under ultraviolet light conditions with the surgeon in surgical positioning. **B**, Series of simulations involving no surgical mask for the patient and a complete seal of the surgical drape. **C**, An ear loop surgical mask (secured with tape) and an incomplete seal of the surgical drape. **D**, Surgical mask (secured with tape) and a complete surgical seal of surgical drape.

Consistent with the present findings, in vitro and clinical studies have shown that placing a surgical mask on patients significantly reduces the dispersion distance of virus-infected bioaerosol from patients.[7] Because droplets still were spread under the drape by the masked patient, operating room personnel should wear appropriate personal protective equipment before reaching under the drape and should perform hand hygiene afterward. Personal protective equipment is essential in protecting healthcare workers from transmissible acute respiratory infections in clinical settings.[3,7] Humans produce respiratory droplets measuring 0.1 to 1000 μm.[7] Studies of cough aerosols and exhaled breath have detected particles smaller than 5 μm from patients with various respiratory infections.[7] Because the smaller particles of coronavirus have the potential to spread over long distances,[7] many surgical centers have implemented nasal cannula instead of external broad flow to deliver oxygen directly into the patient's nasal cavity and to reduce airflow directed toward the surgeon. Given our evolving understanding of severe acute respiratory syndrome coronavirus 2 transmissibility risk factors, reference to the latest local hospital and public health guidelines regarding appropriate personal protective equipment for protection against droplet spread in an operating room setting is recommended.

In each simulation, fluorescent dye was projected onto the surgical field while removing the adhesive drape. Because administration of postoperative drops often requires manual opening of the eyelids, we recommend having an assistant instill postoperative drops before the surgeon removes the speculum and drape. Although coughing likely produces fewer droplets than resuscitation procedures,[6] spread of droplets was visualized under the drape, and hence rapid removal of the drape may be a source of droplet spread.

A limitation of these simulations is that they do not identify the spread of aerosols and very small droplets. Second, alternate rates or methods of oxygen supplementation when applied to a real patient may have variable results. Third, the differences in style and technique of applying the surgical drape may affect the generalizability of these findings. Future studies examining quantification of droplets and aerosol contaminants in other ophthalmic procedures are warranted.

In summary, these simulations demonstrate that the spread of respiratory droplets may be minimized with a patient mask that is taped to the face and a tight seal of the surgical drape. Personnel should be mindful when removing the surgical drape because of the potential for spread of droplets underneath the drape. Furthermore, administration of postoperative drops should be carried out before complete removal of the drape or with clean gloves to avoid direct contact with the patient's face.

Tina Felfeli, MD[*]
Amrit S. Rai, MD[*]
Rosa Braga-Mele, MD, MEd
Efrem D. Mandelcorn, MD, FRCSC
Wendy Hatch, OD, MSc
Amandeep S. Rai, MD, FRCSC

*Department of Ophthalmology and Vision Sciences, University of Toronto, Toronto, Canada*
[*]***Both authors contributed equally as first authors.***

Disclosure(s):
All authors have completed and submitted the ICMJE disclosures form.
The author(s) have no proprietary or commercial interest in any materials discussed in this article.
Supported by the Department of Ophthalmology and Vision Sciences, University of Toronto, Toronto, Canada (quality improvement grant).

HUMAN SUBJECTS: No human subjects were included in this study. Individual patient-level consent was not required.

No animal subjects were included in this study.

Author Contributions:
Conception and design: Felfeli, Amrit S. Rai, Braga-Mele, Mandelcorn, Hatch, Amandeep S. Rai
Analysis and interpretation: Felfeli, Amrit S. Rai, Braga-Mele, Mandelcorn, Hatch, Amandeep S. Rai
Data collection: Felfeli, Amrit S. Rai, Braga-Mele, Mandelcorn, Hatch, Amandeep S. Rai
Obtained funding: Felfeli, Mandelcorn
Overall responsibility: Felfeli, Amrit S. Rai, Braga-Mele, Mandelcorn, Hatch, Amandeep S. Rai

Keywords:
Cataract surgery, COVID-19, Coronavirus, Drape, Droplet spread, Mask, Operating room, Ophthalmic surgery, Surgical, Transmission.

Correspondence:
Amandeep S. Rai, MD, FRCSC, Department of Ophthalmology and Vision Sciences, University of Toronto, 340 College Street, Suite 501, Toronto, Ontario, M5T 3A9, Canada. E-mail: amandeepraimd@gmail.com.

## References

1. Rai AS, Mele R, Rai AS, Braga-Mele R. Addressing the concerns of aerosolization during phacoemulsification due to COVID-19, 10.1097/j.jcrs.0000000000000314 *J Cataract Refract Surg*. 2020 Jul 17. https://doi.org/10.1097/j.jcrs.0000000000000314. Online ahead of print.
2. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med*. 2020;382(12):1177–1179.
3. Felfeli T, Batawi H, Aldrees S, et al. Utility of patient face masks to limit droplet spread from simulated coughs at the slit lamp. *Can J Ophthalmol*. 2020;20(5):e163–e165.
4. Felfeli T, Mandelcorn ED. Assessment of simulated respiratory droplet spread during an ophthalmologic slitlamp examination. *JAMA Ophthalmol*. 2020;138(10):1099–1101.
5. Canelli R, Connor CW, Gonzalez M, et al. Barrier enclosure during endotracheal intubation. *N Engl J Med*. 2020;382(20):1957–1958.
6. Matava CT, Yu J, Denning S. Clear plastic drapes may be effective at limiting aerosolization and droplet spray during extubation: implications for COVID-19. *Can J Anesth*. 2020;67(7):902–904.
7. Prather KA, Wang CC, Schooley RT. Reducing transmission of SARS-CoV-2. *Science*. 2020;368(6498):1422–1424.

## Swept-Source and Spectral-Domain OCT Imaging of Conjunctival Tumors

Conjunctival tumors cover a large number of clinical entities that need to be recognized and documented. Early identification is essential to treat the tumor and optimize therapy results. Anterior segment OCT is useful in the management of ocular surface tumors, and spectral-domain (SD) OCT has been largely used for this purpose.[1–3] The first anterior segment swept-source (SS) OCT was brought to the market in 2008, allowing visualization of the anterior segment of the eye in 1 image and improving the characterization of its deep structures. To our knowledge, no studies have compared SS OCT with SD OCT in the context of conjunctival tumors. To determine whether SS OCT technology is more relevant than SD OCT technology for studying conjunctival tumors, we performed both SD OCT and SS OCT in 11 conjunctival tumors and compared obtained features.

We conducted a cross-sectional pilot study that met the tenets of the Declaration of Helsinki and was approved by the ethics committee of the French Society of Ophthalmology (identifier, 00008855). Written consent was obtained from all participants. All consecutive patients with scheduled conjunctival tumor resection surgery at the University Hospital of Nice were included from July through October 2019. Inclusion criteria were isolated bulbar lesion of the conjunctiva or caruncle. For all patients, slit-lamp photographs, SD OCT, and SS OCT images of the lesion were obtained before excisional surgery. The following clinical parameters were collected for each lesion: location (eye and quadrant) and pigmentation (unpigmented, poorly pigmented, and highly pigmented). Pathologic tumor–node–metastasis staging was performed according to the Classification of Malignant Tumors, Union for International Cancer Control, eighth edition, when applicable. After surgery, histologic analyses were assessed by a pathologist (S.L.).

The devices used were commercial anterior segment SS OCT (Anterion; Heidelberg Engineering, Heidelberg, Germany) and SD OCT (RS-3000 [Nidek, Gamagori, Japan] and Cirrus-HD 5000 [Carl Zeiss Meditec, Dublin, CA]). The following structural features on the OCT images were assessed separately by 2 different senior ocular oncology specialists (S.N.-E. & J.-P.C.): visibility of the basement membrane, internal pattern of the tumor (homogeneous, heterogeneous, or heterogeneous with cysts), visibility of posterior margin, visibility of tumor shadowing posteriorly, quality of posterior shadowing (mild, moderate, or severe) depending on the tumor pigmentation, and overall image quality (high, medium, or low).[4] Swept-source OCT images were identifiable easily by each examiner, and the order of image evaluation between patients