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LETTER TO THE EDITOR

Risk of aerosolization and the importance of corneal hysteresis measurements in Glaucoma patients during the COVID-19 Era

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Dear Editor,

COVID-19 brought about significant changes in the way ophthalmologists practice and manage their patients. Especially with the appearance of the Omicron variant, fear and risk of transmission have increased, leading to changes in the way practices manage patients. Of the equipment suspended from use, non-contact air jet tonometers have been the most affected due to some evidence that suggested that this technology can lead to aerosolization and dissemination of viral particles [1]. There has been some evidence to suggest that SARS-CoV-2 can be detected in the eyes of COVID-19 patients and therefore potentially lead to transmission [2]. However, there has also been evidence pointing to the contrary, suggesting that risk of transmission through the ocular surface is very low [3]. Nonetheless, to err on the side of caution, most ophthalmology practices have temporarily suspended the use of certain non-contact tonometers in order to ensure patient safety.

Within the category of non-contact tonometers is the Ocular Response Analyzer (ORA; Riechert Ophthalmic Instruments, Inc., Buffalo, NY, USA). It measures intraocular pressure (IOP) and corneal hysteresis utilizing a pulse of pressurized air. Corneal hysteresis has been shown to be a proven clinical tool in the prognosis of glaucoma, through correlation with features of structural or functional progression (Table 1). Just like other non-contact tonometers, a general consensus among ophthalmologists has been adopted to suspend the ORA from clinical use in order to prevent any possible COVID-19 transmission. The current dilemma lies in whether enough evidence exists to limit the use of air jet instruments, and whether or not it is more beneficial for glaucoma patients to have corneal hysteresis measured for their disease.

In our glaucoma practice, the ORA was in use until the onset of the pandemic. We looked for a subset of patients who had hysteresis measurements prior to the pandemic and who continued to follow-up throughout the pandemic. In this group, 44 patients (71 eyes) with primary open-angle glaucoma (POAG) had a mean ($\pm$ SD) corneal hysteresis of 9.24 ± 1.55. This is significantly less than our control group (40 patients, 75 eyes), which had a mean ($\pm$ SD) corneal hysteresis of 10.1 ± 1.3 ($p < 0.05$; data not shown). Over the course of the pandemic, many POAG patients exhibited an increased severity of their glaucoma, determined by structural changes on slit lamp biomicroscopy, with a 19% increase in patients developing severe glaucoma. Additionally, the majority of patients had a worsening progression of their glaucoma and an increase in medications used (1.90 ± 1.13 vs. 2.47 ± 1.09, $p < 0.05$). Further analysis of this patient cohort was conducted

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Table 1 Summary table of the correlation between corneal hysteresis and glaucoma progression

Study	Sample size	Mean corneal hysteresis in POAG	Structural progression	Functional progression	Correlation
Prata[a] et al. 2012	42 patients (42 eyes)	8.1 ± 1.8	Increased Cup-to-disk ratio: 0.57 ± 0.16	N/A	$R = 0.41$; $p = 0.01$
Medeiros[b] et al. 2013	68 patients (114 eyes)	9.5 ± 1.7	N/A	Each 1 mm Hg lower corneal hysteresis was associated with a 0.25%/year faster rate of visual field index decline	$B = -0.25$ (0.07); $p < 0.001$
De Moreas[c] et al. 2012	128 patients (128 eyes)	7.5 ± 1.4	N/A	Mean rate of localized visual field change $= -2.5 \pm 1.3$ dB/y	Time adjusted logistic regression multivariate model: corneal hysteresis OR = 1.55 per mm Hg lower; $p < 0.01$
Chee[d] et al. 2013	50 patients (50 eyes)	9.0 ± 1.4	Global glaucomatous progression, RNFL loss	N/A	RNFL OR = 0.5, 95% CI 0.3–0.9, P = .02 Global progression OR: 0.78; 95% CI 0.56–0.99, P = .049
Zhang[e] et al. 2016	133 patients (186 eyes)	9.2 ± 1.8	RNFL loss: 0.13 μm/year	N/A	Univariate analysis: −0.13 loss in RNFL per 1 mmHg lower corneal hysteresis, $p = 0.011$; multivariate analysis: − 0.13 loss in RNFL as a function of time

[a]Prata TS, Lima VC, Guedes LM, et al. (2012) Association between corneal biomechanical properties and optic nerve head morphology in newly diagnosed glaucoma patients. Clin Exp Ophthalmol. 40(7):682–8

[b]Medeiros FA, Meira-Freitas D, et al. (2013) Corneal hysteresis as a risk factor for glaucoma progression: a prospective longitudinal study. Ophthalmology. 120(8):1533–40

[c]De Moraes CV, Hill V, Tello C, et al. (2012) Lower corneal hysteresis is associated with more rapid glaucomatous visual field progression. J Glaucoma. 21(4):209–13

[d]Chee RI, Silva FQ, Ehrlich JR, et al. (2013) Agreement of flicker chronoscopy for structural glaucomatous progression detection and factors associated with progression. Am J Ophthalmol. 155(6):983–990.e1

[e]Zhang C, Tatham AJ, Abe RY, et al. (2016) Corneal Hysteresis and Progressive Retinal Nerve Fiber Layer Loss in Glaucoma. Am J Ophthalmol. 166:29–36

Table 2 Interventions in control and POAG patients with low corneal hysteresis

	Control		POAG	
	Sample size	Corneal hysteresis	Sample size	Corneal hysteresis
Patients with glaucoma medication increases	3 patients (4 eyes)	9.7 ± 1.0	24 patients (34 eyes)	9.1 ± 1.7
Patients without glaucoma medication increases	37 patients (71 eyes)	10.2 ± 1.3	20 patients (37 eyes)	9.4 ± 1.4*
Patients with glaucoma surgical intervention	0 patients (0 eyes)	N/A	11 patients (13 eyes)	8.6 ± 1.3
Patients without glaucoma surgical intervention	40 patients (75 eyes)	10.1 ± 1.3	33 patients (58 eyes)	9.4 ± 1.6*

*$p < 0.05$ versus control

to determine whether or not a lower pre-COVID corneal hysteresis was associated with future medical or surgical interventions. Of the 44 POAG patients, 11 patients (25%) underwent surgical interventions compared to 0 patients in the control group (Table 2). These POAG patients also had low corneal hysteresis (8.6 ± 1.3). When assessing for medical intervention, 55% of POAG patients exhibited increases in medication compared to only 7.5% in the control group.

Corneal hysteresis is one of many parameters used for glaucoma risk stratification, but it is the one that was most affected by COVID-19. With every clinical decision, there is a risk–benefit analysis that clinicians conduct aiming for the best patient outcome. With the improved preventative protocols currently in place for COVID-19, and with vaccinations and mask requirements, we believe that the suspension of the air jet technologies like the ORA from clinical use should be reconsidered. By lacking hysteresis measurements, we may be providing a disservice to patients with progressive glaucoma that require more frequent follow-up and interventions.

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Declarations

Conflict of interest Author, Marko Oydanich, declares no financial interest. Author, Albert S. Khouri, declares the following competing interests: Grant support: Allergan, Optovue, NJ Health Foundation, Speaker Bureau: Aerie, Allergan, Bausch, and Lomb.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent to publish All participants have confirmed the consent to publish.

Ethical approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Institutional Review Board at Rutgers New Jersey Medical School.

References

1. Britt JM, Clifton BC, Barnebey HS et al (1991) Microaerosol formation in noncontact "air-puff" tonometry. Arch Ophthalmol (Chicago, Ill: 1960) 109:225–8
2. Kumar K, Prakash AA, Gangasagara SB et al (2020) Presence of viral RNA of SARS-CoV-2 in conjunctival swab specimens of COVID-19 patients. Indian J Ophthalmol 68:1015–1017
3. Seah IYJ, Anderson DE, Kang AEZ et al (2020) Assessing viral shedding and infectivity of tears in coronavirus disease 2019 (COVID-19) patients. Ophthalmology 127:977–979