Author Response: Choroidal Folds in Astronauts

We would like thank Mader and colleagues[1] for their comments on our study[2] and their invitation to compare the folds and disc edema that occur in microgravity environments with those that occur in idiopathic intracranial hypertension (IIH). Based on our recent reports,[2,3] it is unlikely that we are going to provide new insights into the mechanisms that the correspondents have not already meticulously and exhaustively considered in their original publications.[4,5]

We agree that retinal and choroidal findings in IIH appear to differ from the changes associated with microgravity environments; however, it may be premature to draw any definitive conclusions given the small number of reported cases. Nonetheless, the eye findings in microgravity may differ from IIH in several ways: relatively mild degree of disc edema, ostensible absence of peripapillary wrinkles and retinal folds, higher frequency of choroidal folds, mildly elevated or normal intracranial pressure, and cotton wools spots. If confirmed, these features may reflect a difference in pathophysiology or severity.

The microgravity environment has widespread physiological effects that are not completely understood. In contrast to IIH, the redistribution of body fluids is an important factor that could, in addition to elevating intracranial pressure, also affect the intraorbital pressure, intraocular pressure, ocular blood flow, the material properties of the sclera, and loading force conditions at the scleral flange. Any or all of these effects may induce or modulate the development of folds and disc edema. We suspect that the ophthalmic manifestations of microgravity may have more in common with jugular vein obstruction or venous sinus thrombosis than IIH.

Enhanced optical coherence tomography (OCT) imaging that quantifies shape deformation (i.e., anterior-posterior displacement) of the peripapillary Bruch's membrane layer[6,7] before, during, and after exposure to a microgravity environment may be able to identify differences among these entities and help clarify the underlying mechanisms in each. An analysis of the types and patterns of folds can also provide important information about the nature of the biomechanical forces acting on the optic nerve head. We found that high-resolution rasters and en face OCT are more sensitive than photos in detecting and characterizing the folds in patients with papilledema.[2,3]

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References

1. Mader TH, Gibson CR, Lee AG. Choroidal folds in astronauts. *Invest Ophthalmol Vis Sci*. 2016;57:592.
2. Sibony PA, Kupersmith MJ, Feldon SE, Wang JK, Garvin M; OCT Substudy Group for the NORDIC Idiopathic Intracranial Hypertension Treatment Trial. Retinal and choroidal folds in papilledema. *Invest Ophthalmol Vis Sci*. 2015;56:5670–5680.
3. Sibony PA, Kupersmith MJ; OCT Substudy Group for the NORDIC Idiopathic Intracranial Hypertension Treatment Trial. "Paton's folds" revisited: peripapillary wrinkles, folds, and creases in papilledema [published online ahead of print January 14, 2016]. *Ophthalmology*. doi:10.1016/j.ophtha.2015.12.017.
4. Mader TH, Gibson CR, Pass AF, et al. Optic disc edema, globe flattening, choroidal folds, and hyperopic shifts observed in astronauts after long-duration space flight. *Ophthalmology*. 2011;118:2058–2069.
5. Mader TH, Gibson CR, Pass AF, et al. Optic disc edema in an astronaut after repeat long-duration space flight. *J Neuro-ophthalmol*. 2013;33:249–255.
6. Sibony P, Kupersmith MJ, Honkanen R, Rohlf FJ, Torab-Parhiz A. Effects of lowering cerebrospinal fluid pressure on the shape of the peripapillary retina in intracranial hypertension. *Invest Ophthalmol Vis Sci*. 2014;55:8223–8331.
7. Kupersmith MJ, Sibony P, Mandel G, Durbin M, Kardon RH. Optical coherence tomography of the swollen optic nerve head: deformation of the peripapillary retinal pigment epithelium layer in papilledema. *Invest Ophthalmol Vis Sci*. 2011;52:6558–6664.

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