

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix. STROBE Reporting Guidelines: Additional Details and Exceptions

This manuscript followed the STROBE Reporting Guidelines for a cohort study, with additional details and a few exceptions described below.

1. **Setting:** Dates, including periods of recruitment and data collection, are not included due to attributability concerns for astronaut and cosmonaut crewmembers.
2. **Study size:** A sample size calculation was performed for the larger Fluid Shifts study and determined that a minimum sample size of 10 crewmembers was required. Fourteen crewmembers were included to account for any missing data.
3. **Descriptive Data:** Missing data are described below:
 - a. One subject dropped out of the study after flight day (FD) 50 for reasons unrelated to the study
 - b. Lower body negative pressure (LBNP) data was not included for two subjects:
 - i. One subject did not participate in inflight LBNP due to development of a retinal hemorrhage
 - ii. One subject had scan quality issues on FD50 and scheduling constraints on FD150
 - c. Five Russian subjects were unable to return for imaging 10 days after return to Earth (R+10) due to travel constraints

All other items on the STROBE checklist are addressed in the main text of the manuscript.

eTable 1. *P* Values for Change in Each Parameter During and After Spaceflight Relative to the Preflight Seated Value

	FD50 vs. Preflight	FD150 vs. Preflight	R+10 vs. Preflight	R+30 vs. Preflight	R+180 vs. Preflight
MRW (μm)	< .001	< .001	< .001	.007	.46
Cup volume (mm^3)	< .001	< .001	< .001	< .001	> .99
BMO height (μm)	.06	.009	.78	.97	.24
TRT250 (μm)	< .001	< .001	< .001	.002	.36
TRT500 (μm)	< .001	< .001	< .001	.002	.24
TRT1000 (μm)	.72	.02	.27	.13	.02
TRT1500 (μm)	.33	.77	.46	.96	.007
MT500 (μm)	< .001	< .001	< .001	.003	.07
MT1500 (μm)	< .001	< .001	< .001	.38	.13
MT2500 (μm)	.11	.10	.06	.53	.41

MRW, minimum rim width; BMO, Bruch’s membrane opening; TRT, total retinal thickness; TRT250, TRT from BMO to 250 μm ; TRT500, TRT from 250 to 500 μm ; TRT1000, TRT from 500 to 1000 μm ; TRT1500, TRT from 1000 to 1500 μm ; MT, macular thickness; MT500, MT from the fovea to 500 μm ; MT1500, MT from 500 to 1500 μm ; MT2500, MT from 1500 to 2500 μm ; FD, flight day; R+, days after return to Earth.

The R+10 time point includes only 8 subjects, as several international crewmembers did not return directly to Houston

eTable 2. Estimated Marginal Mean (95% CI) for Each Parameter Without and With Lower-Body Negative Pressure During Spaceflight

	FD50	FD50 + LBNP	FD150	FD150 + LBNP
MRW (μm)	386.4 (349.2 – 423.5)	385.6 (348.3 – 422.8)	398.6 (361.4 – 435.8)	402.1 (364.9 – 439.3)
Cup volume (mm³)	0.167 (0.076 – 0.258)	0.168 (0.077 – 0.259)	0.158 (0.067 – 0.249)	0.155 (0.063 – 0.246)
BMO height (μm)	-124.7 (-156.3 – -93.0)	-125.0 (-156.7 – -93.3)	-127.2 (-158.8 – -95.6)	-122.2 (-153.9 – -90.6)
TRT250 (μm)	413.0 (387.5 – 438.6)	412.9 (387.3 – 438.5)	424.4 (398.9 – 450.0)	427.3 (401.7 – 452.9)
TRT500 (μm)	381.7 (365.4 – 398.1)	381.0 (364.6 – 397.4)	387.6 (371.2 – 404.0)	388.6 (372.2 – 405.0)
TRT1000 (μm)	339.9 (329.3 – 350.5)	339.6 (329.0 – 350.2)	341.5 (330.9 – 352.0)	341.9 (331.3 – 352.5)
TRT1500 (μm)	303.2 (294.9 – 311.4)	303.2 (294.9 – 311.4)	302.7 (294.5 – 311.0)	303.4 (295.1 – 311.7)
MT500 (μm)	268.7 (258.6 – 278.7)	269.5 (259.4 – 279.6)	267.2 (257.1 – 277.2)	267.0 (256.9 – 277.1)
MT1500 (μm)	345.5 (336.6 – 354.4)	345.9 (336.9 – 354.8)	344.4 (335.5 – 353.4)	344.2 (335.3 – 353.2)
MT2500 (μm)	314.8 (307.1 – 322.4)	315.3 (307.6 – 322.9)	314.7 (307.1 – 322.4)	314.0 (306.3 – 321.7)

MRW, minimum rim width; BMO, Bruch’s membrane opening; TRT, total retinal thickness; TRT250, TRT from BMO to 250 μm; TRT500, TRT from 250 to 500 μm; TRT1000, TRT from 500 to 1000 μm; TRT1500, TRT from 1000 to 1500 μm; MT, macular thickness; MT500, MT from the fovea to 500 μm; MT1500, MT from 500 to 1500 μm; MT2500, MT from 1500 to 2500 μm; FD, flight day; LBNP, lower body negative pressure.

eTable 3. *P* Values for Change in Each Parameter With LBNP and Between-Flight Days Without LBNP

	FD50 vs. FD50 + LBNP	FD150 vs. FD150 + LBNP	FD50 vs. FD150
MRW (μm)	.76	.20	< .001
Cup volume (mm^3)	.85	.06	< .001
BMO height (μm)	.90	.07	.31
TRT250 (μm)	.93	.17	< .001
TRT500 (μm)	.63	.28	< .001
TRT1000 (μm)	.63	.43	.04
TRT1500 (μm)	.94	.15	.43
MT500 (μm)	.30	.84	.046
MT1500 (μm)	.54	.76	.06
MT2500 (μm)	.32	.18	.99

MRW, minimum rim width; BMO, Bruch's membrane opening; TRT, total retinal thickness; TRT250, TRT from BMO to 250 μm ; TRT500, TRT from 250 to 500 μm ; TRT1000, TRT from 500 to 1000 μm ; TRT1500, TRT from 1000 to 1500 μm ; MT, macular thickness; MT500, MT from the fovea to 500 μm ; MT1500, MT from 500 to 1500 μm ; MT2500, MT from 1500 to 2500 μm ; FD, flight day; LBNP, lower body negative pressure.

eTable 4. Estimated Marginal Mean (95% CI) for Each Parameter With Posture Changes Before and After Spaceflight

	Preflight Seated	Preflight Supine	Preflight HDT	R+10 Seated	R+10 Supine	R+10 HDT
MRW (μm)	359.5 (330.3 – 388.6)	360.8 (331.6 – 389.9)	363.6 (334.4 – 392.7)	380.7 (351.4 – 410.0)	380.2 (351.0 – 409.5)	383.5 (354.2 – 412.7)
Cup volume (mm^3)	0.193 (0.102 – 0.284)	0.197 (0.106 – 0.288)	0.190 (0.099 – 0.281)	0.162 (0.071 – 0.253)	0.163 (0.072 – 0.255)	0.160 (0.069 – 0.251)
BMO height (μm)	-118.3 (-146.7 – -89.8)	-122.7 (-151.2 – -94.3)	-121.2 (-149.7 – -92.8)	-114.0 (-142.6 – -85.3)	-115.9 (-144.5 – -87.3)	-112.9 (-141.5 – -84.2)
TRT250 (μm)	394.3 (375.9 – 412.7)	391.8 (373.4 – 410.1)	394.2 (375.8 – 412.6)	410.0 (391.5 – 428.5)	409.8 (391.3 – 428.3)	412.6 (394.2 – 431.1)
TRT500 (μm)	370.9 (358.6 – 383.2)	370.2 (357.9 – 382.5)	370.9 (358.6 – 383.2)	381.1 (368.7 – 393.5)	379.9 (367.5 – 392.3)	381.2 (368.8 – 393.5)
TRT1000 (μm)	337.6 (327.7 – 347.5)	337.1 (327.2 – 347.0)	336.9 (327.0 – 346.8)	340.5 (330.6 – 350.4)	340.2 (330.3 – 350.1)	339.5 (329.6 – 349.4)
TRT1500 (μm)	302.5 (294.2 – 310.8)	302.1 (293.8 – 310.5)	301.7 (293.4 – 310.1)	302.4 (294.1 – 310.8)	302.4 (294.0 – 310.8)	302.3 (294.0 – 310.7)
MT500 (μm)	272.4 (262.7 – 282.1)	272.0 (262.3 – 281.7)	271.1 (261.4 – 280.9)	267.6 (257.8 – 277.3)	266.7 (257.0 – 276.5)	265.9 (256.1 – 275.6)
MT1500 (μm)	348.1 (339.3 – 356.9)	348.5 (339.7 – 357.3)	348.1 (339.3 – 356.9)	345.1 (336.3 – 353.9)	344.3 (335.5 – 353.1)	343.7 (334.9 – 352.6)
MT2500 (μm)	315.7 (307.9 – 323.5)	316.3 (308.5 – 324.2)	316.0 (308.2 – 323.8)	314.7 (306.8 – 322.5)	314.3 (306.5 – 322.2)	313.6 (305.8 – 321.4)

MRW, minimum rim width; BMO, Bruch’s membrane opening; TRT, total retinal thickness; TRT250, TRT from BMO to 250 μm ; TRT500, TRT from 250 to 500 μm ; TRT1000, TRT from 500 to 1000 μm ; TRT1500, TRT from 1000 to 1500 μm ; MT, macular thickness; MT500, MT from the fovea to 500 μm ; MT1500, MT from 500 to 1500 μm ; MT2500, MT from 1500 to 2500 μm ; HDT, head-down tilt; R+, days after return to Earth.

The R+10 time point includes only 8 subjects, as several international crewmembers did not return directly to Houston.