Author Response: In Vivo Oxygen Uptake into the Human Cornea

Fink and Hill[1] question the transport of oxygen to the detection probe during in vivo polarographic assessment of corneal oxygen uptake. Polarographic measurement of corneal oxygen uptake is based on electrochemical reduction of oxygen at the surface of a Clark electrode.[2]

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^- \quad (1)$$

This reaction demands four electrons for every oxygen molecule consumed and, accordingly, gives rise to a cathodic current. Electrical current resulting from the reduction process in reaction 1 is measured by the polarographic instrument.[2] Without a supply of oxygen to the electrode surface (i.e., a diffusion flux), reaction 1 cannot consume oxygen, no electrical current can arise, and no instrument signal is possible. We reiterate that the polarographic oxygen sensor (POS) directly measures the electrical current arising from the consumption of oxygen following reaction 1 and not oxygen partial pressure.[3] If there is no supply of oxygen to the electrode surface, reaction 1 ceases and no measurement can be made. A detectable instrument signal demands a flux of oxygen directed from the membrane towards the electrode. Our approach faithfully represents this well established physical fact, whereas the currently used analysis of Jauregui and Fatt[4] demands a zero oxygen flux to the electrode. Consequently, the data-interpretation scheme of Fatt and coworkers for the POS is inconsistent with the factual physical behavior of the Clark electrode. The schematics in Figures 1 and 2 simply illustrate this established fact.[3]

The sample size of our human subject trial was not large enough to assert a definitive value for corneal oxygen uptake. Nevertheless, our value does fall within the range cited for a sample size of 100.[5] We stand by our analysis and interpretation scheme for the POS, and we strongly recommend that future measurements be so interpreted.

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