Measuring the Spectral Transmittance of the Human Eyelid

Retinal light exposures can affect non-visual systems like those controlling alertness, hormone production, and timing of the sleep-wake cycle. The human eyelid shelters the eye from light, but the eyelid is not opaque; therefore, eyelid-filtered light could potentially also stimulate some of these non-visual effects.

Researchers at the Lighting Research Center developed a technique to practically and accurately measure eyelid transmittance across the visible portion of the electromagnetic spectrum, paying particular attention to decreasing stray light and increasing the signal-to-noise ratio in the eyelid spectral transmission measurements. Directly placing a very small, calibrated source behind the eyelid with a fixed detector in front (see photos, below) provided greater measurement sensitivity than could be obtained from previously reported methods.

Eyelid transmittance was measured from 27 subjects. Results showed that the eyelid has a much higher optical density at short wavelengths than was previously published. The mean ± s.d. optical density of the eyelid from 450 nm to 650 nm was 2.1 ± 0.3 with an optical density range among subjects of approximately 1.0 across the entire spectral range. The mean transmittance at 630 nm was approximately 9%, while the mean transmittance at 550 nm was approximately 0.5% and 0.4% at 490 nm.

Furthermore, researchers found that skin pigmentation is poorly correlated with eyelid transmission. In fact, eyelid transmission is most likely affected by eyelid thickness and wavelength-independent macromolecules in the eyelid, such as keratinocytes, collagen, and fat. Together with data on the absorption and scattering characteristics of the constituents of the skin, a method for predicting relative eyelid transmission at any wavelength was developed (see figure, above).

Sponsor
Philips Respironics