Objective Refraction

Pupil Radius [mm]

Traditional objective refraction metrics depend on the objective pupil radius \( r_p \), but they don’t take into account the subjective pupil radius that the subject has during clinical subjective refraction, and in typical daily conditions.

Different metrics predict slightly different equivalent spheres from the same wavefront data.

\[
M_{\text{minRMS}} = - \frac{4\sqrt{3}C_2^0}{r_p^2} \\
M_{\text{parax}} = - \frac{4\sqrt{3}C_2^0 + 12\sqrt{5}C_4^0 - 24\sqrt{7}C_6^0}{r_p^2}
\]

Purpose: To develop an objective refraction formula based on the ocular wavefront error expressed in terms of Zernike coefficients and pupil radius, that would be an accurate predictor of subjective spherical equivalent (SE) for different pupil sizes.

We propose a new metric, that fits an equivalent sphere to the ocular wavefront at the centre and at a variable distance “\( t \)” between the centre and edge of the pupil. The optimal fitting distance \( t_{\text{opt}} \) is obtained empirically from a dataset of 308 eyes.

Mean SOE (\( \triangle \) Subjective - Objective Refraction Error)

Conclusions: For small pupil radii \( r_p < 2.25 \text{mm} \), all of the wavefront refraction metrics are similarly accurate in predicting the equivalent sphere (mean SOE < 0.1D). For large pupil radii, however, the mean absolute SOE error of traditional metrics increases beyond 0.25D, which is clinically significant. The solution proposed in the study addresses this problem, and takes into account the effects of SA. The MTR wavefront refraction metric is designed to depend on the pupil radius, applying more or less weight to the SA coefficients in function of \( r_p \).