1. Introduction

Automated objective refractometers have been used since the late 1960s. As they are easy to operate, non invasive and quicker than other techniques of refraction, they are widely used in optometric and ophthalmic research, mostly as a starting point for subjective refraction. The aim of the study was to evaluate the repeatability and accuracy of a new generation autorefracto-keratometer (HRK-7000 Huvitz), based on wavefront aberrometry with non-cycloplegic and cycloplegic subjective refraction.

2. Methods

Participants: Right Eyes of 43 healthy myopes (mean age: 28±6 yrs). Mean spherical equivalent: R:-5.07±2.11 D

Refractive error was converted into a vector representation using Fourier decomposition in three components:

(1) Mean Spherical Equivalent (MSE),
(2) J_45 (astigmatism at 180° or 90°)
(3) J_o (oblique astigmatism at 45° or 135°)

Data analysis: Agreement between HRK-7000 and subjective measurements was evaluated using Bland-Altman analysis. Statistical differences between various variables were estimated and analyzed using SPSS 17.0 (SPSS Inc., Chicago, IL, USA). P values < 0.05 were considered statistically significant.

3. Results: Repeatability & Accuracy

(a) Repeatability

Without cycloplegia, the mean difference between the 1st and 2nd measurement was 0.01±0.19 D for S.E (p=0.92), 0.00±0.02 D for the J_45 (p=0.69) and -0.01±0.06 D for the J_o (p=0.62) component of the prescription.

In the presence of cycloplegia test-retest repeatability was 0.01±0.15 D for S.E (p=0.48), 0.02±0.09 D for J_45 (p=0.19) and 0.02±0.07 D for J_o (p=0.09).

The average S.E. with HRK-7000 changed from -5.07±2.11 D to -4.75±1.99 D under cycloplegia, presenting a hyperopic shift of 0.32±0.30 D (p<0.001)

(b) Accuracy

Without cycloplegia, the mean difference between the 1st and 2nd measurement was 0.01±0.30 D for J_45 (p=0.09) and 0.24±0.24 D (p=0.001) without and with cycloplegia, respectively. Measurements of the S.E with HRK-7000 were less myopic than subjective refraction.

With cycloplegia, the mean difference between HRK-7000 and subjective refraction was -0.02±0.12 D (p=0.287) and 0.05±0.08 D (p=0.001) for the J_45 and the J_o component respectively.

In the presence of cycloplegia, there was no significant difference with either the J_45=0.01±0.13D (p=0.573) or the J_o=0.04±0.1D (p=0.06) component.

The HRK-7000 auto Refracto-Keratometer, based on wavefront aberrometry, using the Hartmann-Shack principle. The refractive error is derived from the 2nd order wavefront aberrations (defocus, astigmatism) for a 4 mm pupil. Wavefront sampling is achieved by a 25 micro-tensel array which creates a number of separate focal spots, providing a more detailed information on ocular refraction compared to standard refractometers.

The HRK-7000 and subjective refraction. The dashed line in the lower graph is the least square regression fit and the dotted lines are the 95% limits of agreement between two methods of clinical measurement.

4. Conclusions

- The HRK-7000 forms a fast and reliable objective refractive tool for general optometric practice and ophthalmic research.
- HRK-7000 showed high repeatability in all components of spherocylindrical refraction, especially under cycloplegia.
- There was no clinical difference between the results of the HRK-7000 (with a 4.0 mm pupil) and subjective refraction for either the spherical equivalent of the prescription or the J_45 and J_o components.
- HRK-7000 spherocylindrical refraction was in better agreement with the subjective refraction under cycloplegia, underestimating though the spherical component of the refractive error in high myopic eyes.
- Future work on HRK-7000 could focus on its repeatability and accuracy on measuring pathological eyes, such as in keratoconus, or in post refractive surgery.

References


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