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Title: Laboratory, clinical, and kindergarten test of a new eccentric infrared photorefractor (PowerRefractor)

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Abstract: Purpose: Photorefraction is a convenient way to determine refractive state from a distance. It is, therefore, useful for measuring infants and noncooperative subjects. However, its reliability (or precision) and accuracy (or validity) has been questioned. In a study in subjects without cycloplegia, we have tested whether, after complete automatization, eccentric photorefraction at a 1-m distance can be as reliable as a common autorefractor. Methods: In a laboratory study of 15 student subjects without the use of cycloplegia (30 eyes, refractive errors ranging from -6 D to +6 D), age 25 to 31 years, the photorefractive measurements were compared with spectacle prescriptions. In a clinical study, photorefraction, autorefraction, and subjective refraction were performed in 40 patients without cycloplegia (refractive errors ranging from -4 D to +4 D), most of them with various ocular pathologies. Subjective refractions were obtained by an experienced clinical ophthalmologist but were not accessible to the examiner who used the two refractors. Visual acuity was 20/20 or better except for five subjects. Ages ranged from 6 to 75 years. In the kindergarten screening study, 108 children aged 3 to 6 years were screened for refractive errors. Results: In the laboratory study, it was found that the mean difference between spectacle prescription and PowerRefractor measurements was <0.6 D for spheres and below 0.4 D for cylinders. In the clinical study, data were obtained by all three procedures in 78 eyes. The photorefractor and the autorefractor performed similarly for spheres (mean absolute dioptric difference between refractor and subjective measure: 0.593 D and 0.696 D) and cylinders (mean absolute dioptric differences: 0.399 D and 0.389 D). However, the photorefractor was superior with regard to the measurement of the magnitude and axis of astigmatism (mean weighted difference between objective and subjective axis 0.644 D and 0.769 D, respectively). In the kindergarten study, it was found that the PowerRefractor was very convenient to handle. The autorefractor measured more myopic refractions than the PowerRefractor (mean of the left eyes 0.11 +/- 1.1 D vs. 0.62 +/- 0.53 D, $p < 0.001$). There was no indication that the PowerRefractor failed to detect hyperopia, because ail but one child with more than 2 D of hyperopia measured with autorefractor (n = 7) was also hyperopic with the PowerRefractor. Furthermore, presenting an interesting fixation target at a 3-m distance did not cause more hyperopic refractions, indicating that the camera of the PowerRefractor at a 1-m distance was not a significant stimulus to accommodation. Conclusions: The PowerRefractor was shown to have comparable or slightly better reliability and accuracy

than a modern autorefractor; however, it has major advantages over current autorefractors in that it is faster, measures both eyes at once, and gives interpupillary distance, pupil size, and information on the alignment of the eyes at the same time.
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