



ORIGINAL ARTICLE

Comparison of refractive assessment by wavefront aberrometry, autorefraction, and subjective refraction[☆]



Jeffrey R. Bennett^{a,*}, Gina M. Stalboerger^a, David O. Hodge^b, Muriel M. Schornack^a

^a Department of Ophthalmology, Mayo Clinic¹, Rochester, MN, United States

^b Biostatistics Unit, Mayo Clinic, Jacksonville, FL, United States

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KEYWORDS

Aberrometry;
Autorefraction;
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Abstract

Purpose: To compare refractive assessment results obtained with an aberrometer, an autorefractor, and manual subjective refraction (SR) in a healthy population with optimal visual potential.

Methods: Sixty adults aged 18–59 years with visual acuity of 20/25 or better, no media opacity, and no known corneal or retinal abnormalities were recruited during the course of routine eye examination. Refractive error in both eyes of each patient was assessed by 3 methods: manual SR, a Nidek 530-A autorefractor (AR), and a Nidek OPD-II Scan wavefront aberrometer (OPD). The order of testing was randomized. One technician collected all OPD and AR measurements, and 1 optometrist performed manual SR. Refractive measurements were converted from spherocylindrical prescriptions to power vectors and compared between methods by 2-factor repeated measures and Bland–Altman analysis.

Results: Analysis of the power vectors followed by a log transformation showed no significant difference in refractive results between AR, OPD, and SR ($P = .63$). Bland–Altman analysis identified mean differences (95% CI of limits of agreement) of -0.06 (-0.67 to 0.55) for OPD vs SR, 0.001 (-0.522 to 0.524) for AR vs SR, and 0.06 (-0.541 to 0.662) for AR vs OPD.

Conclusion: Agreement between all refractive assessments was comparable to previously reported agreement between repeated measures of SR. Agreement between AR and SR was slightly stronger than between OPD and SR. Although both the OPD and AR results, in general, showed a high level of agreement with SR, results beyond $\pm 0.50D$ (5.8% for AR, 10% for OPD) would discourage prescribing spectacles directly from either instrument.

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Abbreviations: AR, Nidek 530-A autorefractor; COAS, Complete Ophthalmic Analysis System; OPD, Nidek OPD-II scan aberrometer; SR, subjective refraction.

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* Corresponding author at: Department of Ophthalmology, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, United States.

E-mail address: bennett.jeffrey@mayo.edu (J.R. Bennett).

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PALABRAS CLAVE

Aberrometría;
Autorefracción;
Refracción;
Errores Refractivos;
Frente de onda

Comparación de la evaluación refractiva mediante aberrometría por frente de onda, autorefractómetro y refracción subjetiva

Resumen

Objetivo: Comparar los resultados de la evaluación refractiva obtenidos mediante aberrómetro, autorefractómetro y refracción subjetiva manual (RS) en una población sana con un potencial visual óptimo.

Métodos: Se reclutó a sesenta adultos de edades comprendidas entre 18 y 59 años, con agudeza visual de 20/25 o superior, sin opacidad de medios, y sin anomalías retinianas o corneales, en el curso de un examen ocular rutinario. Se evaluó el error refractivo en los dos ojos de cada paciente mediante tres métodos: RS manual, un autorrefractómetro (AR) Nidek 530-A, y un aberrómetro por frente de onda Nidek OPD-II Scan (OPD). El orden de las pruebas fue aleatorio. Un técnico recolectó todas las mediciones de OPD y AR, y un optometrista llevó a cabo la RS manual. Las mediciones refractivas se transformaron de prescripciones esferocilíndricas en vectores de potencia, comparándose entre sí los tres métodos mediante mediciones repetidas de dos factores y análisis de Bland-Altman.

Resultados: El análisis de los vectores de potencia, seguido de una transformación logarítmica, no reflejó ninguna diferencia significativa de los resultados refractivos entre AR, OPD, y RS ($P=0,63$). El análisis de Bland-Altman identificó diferencias medias (95% de IC de los límites de acuerdo) de $-0,06$ ($-0,67-0,55$) D para OPD frente a RS, $0,001$ ($-0,522-0,524$) D para AR frente a RS, y $0,06$ ($-0,541-0,662$) D para AR frente a OPD.

Conclusión: La concordancia entre todas las evaluaciones refractivas fue comparable a la concordancia previamente reportada entre las mediciones repetidas de RS. La concordancia entre AR y RS fue ligeramente superior que entre OPD y RS. Aunque en general los resultados de OPD y AR reflejaron un elevado nivel de concordancia con RS, los resultados que exceden la diferencia de $\pm 0,50$ D (5.8% para AR, 10% para OPD) no permiten realizar la prescripción de gafas con cualquiera de ambos instrumentos.

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Introduction

Manual subjective refraction (SR), which is frequently based on manual retinoscopy or current spectacle prescription, is the standard for comparison of new instruments that assess refractive error in clinical practice.¹⁻⁵ The status of SR as the standard for determination of spectacle prescription has been established by convention and by the definition of "endpoint" as the combination of lenses that provides the best-corrected visual acuity. However, the procedure is, by definition, subjective. Variability in patient responses to small changes in prescription, along with intraexaminer and interexaminer inconsistency, limits the precision and repeatability of the procedure.⁶⁻⁹ In addition, considerable practice is required to master the technique of manual SR, and the process of performing the test can be clinically time-consuming. Therefore, technology that could decrease the time required for refraction, or even allow for delegation of refractive data collection to technicians, could potentially increase efficiency in optometric practice.

Two such technologies are autorefractors and wavefront aberrometers. Autorefraction is widely accepted as a clinically valuable starting point for SR.^{1,2,8,9} Autorefractors offer rapid automated assessment of refractive error and are now commonly used in ophthalmic practice. Along with autolensometers and automated phoropters, they can be incorporated into comprehensive automated SR systems that allow technicians with minimal training to collect and

refine refractive data. Both SR and autorefraction measure low-order aberrations: sphere (defocus) and astigmatism. However, higher-order aberrations (coma, trefoil, spherical aberration) can also degrade the quality of the optical image received by the retina. Wavefront aberrometers can measure both lower- and higher-order aberrations. If superior visual acuity can be achieved by correction of higher-order aberrations compared with a spherocylindrical prescription, aberrometry could eventually replace SR as the standard for refractive assessment.

The purpose of this study was to evaluate agreement in the spherocylindrical prescription generated by an aberrometer, refractive assessment by an autorefractor, and manual SR in an optometric clinic. If the data obtained by the different methods are comparable, use of an automated system may decrease the time needed to collect refractive data without loss of prescription accuracy. Because adult patients without significant eye problems represent the largest patient demographic group seen in our clinic for routine eye examination, use of an automated method may then substantially increase the productivity of our clinic.

Methods**Patients**

This study was approved by our institutional review board, and the research followed the tenets of the Declaration of

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