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An evaluation of the Nikon Retinomax on a geriatric population

Rosiland Hursh
Pacific University

Dawn Wattenhofer
Pacific University

Bobin Mont
Pacific University

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An evaluation of the Nikon Retinomax on a geriatric population

Abstract
Background: The viability of using objective refraction techniques in the geriatric population for on-site nursing home care was assessed. The results of the three objective methods of refraction, manual retinoscopy, and two commercially available infrared autorefractors (handheld Nikon Retinomax and the table mounted Nidek), were compared.

Methods: One hundred and eighteen eyes from patients in area senior centers were initially evaluated ophthalmically. The pupil size, media opacities, and macular appearance were graded following template guides. The eyes were then refracted manually and using the two autorefractors. Autorefractor measurements were repeated per manufacturer’s instructions. LogMAR visual acuity was recorded with the manual and the autorefractor corrections; as well as with the patient’s initial spectacle prescription if applicable.

Results: Visual acuity with the Nidek autorefraction corrections was on average one line better than with the Retinomax autorefraction corrections. There was, however, no statistical significance in visual acuity when evaluating the three methods of refraction in eyes with opacities of Grade 2 or more, or in the category of small pupils ( < 2.5mm). The mean dioptric difference between all three methods of refraction was less than 0.25D in all categories. A total of twenty-eight eyes was rejected due to the instruments’ inability to yield a refraction or because of missing visual acuities. The Nidek autorefractor had the most rejected measurements with eighteen eyes, the Retinomax had three rejections, and retinoscopy had none; the remaining rejections were due to missing visual acuities.

Conclusion: The results suggested that all three methods of refraction yield similar equivalent sphere results. The refractive error corrections obtained from the Retinomax did, however, on average provide one line less visual acuity, but of the two autorefractors it had significantly less rejected measurements than the table mounted Nidek. Ease of measurement for the practitioner and the patient, as well as its portability make the Retinomax a viable option for the geriatric population.

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Thesis

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AN EVALUATION
OF THE NIKON RETINOMAX
ON A GERIATRIC POPULATION

By

ROSILAND HURSH
DAWN WATTENHOFER
BOBIN MONT

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
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Advisor:

Lee Ann Remington, O.D., M.S.
SIGNATURES

Faculty Advisor

signature
Lee Ann Remington, O.D., M.S.

Authors

signature
Rosliland Hursh

signature
Dawn Wattenhofer

signature
Bobin Mont
Rosiland Hursh received her undergraduate degree from the University of Idaho. She served as the student AOA speaker series chairman. She is also extremely active in Amigos eyecare, where she served as the fundraising chair and she also traveled with the San Jose del Cabo team to provide eyecare to the underprivileged. Roz is also an active member in COVD, OEP, AAO, and NOSA. Roz hopes to practice in the Portland, OR area.

Dawn Wattenhofer attended Black Hills State University before coming to Pacific University. She attained her Bachelor's of Visual Science degree at Pacific. Dawn served as the American Academy of Optometry student liaison for two years. She is also an active member in COVD, OEP, NOSA, and the Beta Sigma Kappa Honorary. Dawn hopes to practice in the Rocky Mountain region.

Bobin Mont received her Bachelor's of Science degree from the University of Wyoming. She served as the Optometric Extension Program student liaison for two years. She is active in Amigos and was able to travel to Jamaica to provide eyecare services to the needy. Bobin is also a member in AAO, COVD, NOSA, and Beta Sigma Kappa Honorary. Bobin hopes to return to the Rocky Mountains to practice.
ABSTRACT

BACKGROUND
The viability of using objective refraction techniques in the geriatric population for on-site nursing home care was assessed. The results of the three objective methods of refraction, manual retinoscopy, and two commercially available infrared autorefractors (handheld Nikon Retinomax and the table mounted Nidek), were compared.

METHODS
One hundred and eighteen eyes from patients in area senior centers were initially evaluated ophthalmically. The pupil size, media opacities, and macular appearance were graded following template guides. The eyes were then refracted manually and using the two autorefractors. Autorefractor measurements were repeated per manufacturer’s instructions. LogMAR visual acuity was recorded with the manual and the autorefractor corrections; as well as with the patient’s initial spectacle prescription if applicable.

RESULTS
Visual acuity with the Nidek autorefraction corrections was on average one line better than with the Retinomax autorefraction corrections. There was, however, no statistical significance in visual acuity when evaluating the three methods of refraction in eyes with opacities of Grade 2 or more, or in the category of small pupils (< 2.5mm). The mean dioptric difference between all three methods of refraction was less than 0.25D in all categories. A total of twenty-eight eyes was rejected due to the instruments’ inability to yield a refraction or because of missing visual acuities. The Nidek autorefractor had the most rejected measurements with eighteen eyes, the Retinomax had three rejections, and retinoscopy had none; the remaining rejections were due to missing visual acuities.

CONCLUSION
The results suggested that all three methods of refraction yield similar equivalent sphere results. The refractive error corrections obtained from the Retinomax did, however, on average provide one line less visual acuity, but of the two autorefractors it had significantly less rejected measurements than the table mounted Nidek. Ease of measurement for the practitioner and the patient, as well as its portability make the Retinomax a viable option for the geriatric population.
ACKNOWLEDGEMENTS

We would like to express gratitude to everyone who helped make this research project operational. Firstly, we would like to thank Dr. A.J. Zelada for taking time out of his busy private practice to come to every senior center screening and perform manual retinoscopy for hours on end. A special thanks also for all of his help in planning the nursing home screenings themselves. His insight into the geriatric population through his practice experience was invaluable.

Thank you also to our faculty advisor, Dr. Lee Ann Remington for being at all the nursing home screenings, helping in the planning and implementing stages, and for all of her advise throughout writing the thesis itself.

A special thank you to Dr. Robert Yolton for taking time out of his busy schedule to help us muddle through the statistics. His help was invaluable in evaluating the results. We greatly appreciate his dedication to the overall the coordination of thesis class.

We would also like to thank the Nikon corporation for loaning Pacific University a Retinomax to be used throughout the thesis project. Their enthusiasm to academic excellence is exemplary.

We would also like to thank all of the Pacific University students who traveled to the onsite screenings. The screenings were a great deal of hard work, and the students only reward for helping was a furthering of their educational experience.

Lastly, we would like to express our gratitude for the funding provided by the Beta Sigma Kappa research grant committee.
Twelve percent of the population in America is over sixty-five years of age and forty percent of these are over the age of eighty-five. Between the years 2020 and 2030 it is estimated that one in five Americans will be sixty-five years or older and the number of people over eighty-five will quadruple. Currently those eighty-five and older constitute forty-five percent of the nation's nursing home population. In a society where an increasing proportion of the population is living in some sort of assisted care facility, optimization of efficient as well as portable eyecare is of considerable importance. Likewise, as the population ages and subjective responses are often limited by aphasia and incoherence, the need for more objective measurements of refraction is essential.

Although it has previously been suggested that autorefractors have good reliability and there is reasonable agreement between refraction obtained manually and that obtained using an autorefractor in normally sighted ametropes\(^1\), there is reason to believe that autorefractors are less likely to perform as well with the 65 and older population. The performance of all types of autorefractors decreases as the signal to noise ratio decreases. We feel that factors that would affect the signal to noise ratio are predominant among this group of people. These factors include:

1. lens opacities from cataracts or residual capsular opacities and reflections from intraocular lenses, all of which could cause forward scattering of the beam of light
2. miotic pupils which would not allow complete passage of the light beam
3. postural problems which would limit the alignment of the autorefactor instrument
4. the presence of macular pathology which affects the plane of polarization and reflectance of the measuring beam.

The first two factors primarily affect the autorefractors which are based on the Scheiner disk principles whereas macular pathology affects instruments based on the principle of image analysis. The postural concern occurs with those autorefractors that are mounted to a table, in which the patient, who is arthritic, wheel chair bound, bed bound, etc, is unable to position correctly.

This study was performed to compare the efficacy of autorefractors in the geriatric population. The Nikon handheld autorefractor has been promoted for use in this population, predominantly due its portability and ease of maneuverability for those postural hindered patients. The study evaluates this autorefractor as well as a table-mounted refractor, and that of a manual retinoscopic refraction.

**METHODS**

Data was collected from 118 left and right eyes of patients over the age of 65 years who were recruited from two Portland, OR area senior centers. The subjects first were prescreened for pre-testing visual acuity, pupil size and function, corneal opacities, lens opacities and retinal abnormalities. Pre-testing visual acuity was measured by obtaining the current prescription with lensometry, and measuring the visual acuities (OD and OS) through a trial frame with that correction using a wall mounted logMAR Bailey Lovie chart set at 6 meters under standard lighting conditions. Pupil size was measured using a PD ruler and the function was assessed using a penlight/transluminator with the examiner evaluating the direct and consensual pupil response. Corneal opacification was assessed using direct opthalmoscopy. Lens opacities were graded by density and an
estimate of the pupillary area affected using direct ophthalmoscopy. Ocular disease was assessed using direct ophthalmoscopy. The following conditions excluded patients from the study: serious ocular disease and visual acuity less than 20/200.

The objective refraction was determined using the Nikon Retinomax (Nikon, Melville, NY), the Nidek Autorefractor AR-1100 (Nidek, Palo Alto, CA) and trial frame retinoscopy. These measurements were taken by three examiners (RLH, DLW, and AJZ). The refractive results of each technique were randomly trial framed and OD and OS visual acuities taken using a wall mounted logMAR Bailey Lovie chart under standard lighting conditions. The examiners were not informed of the visual acuities.

RESULTS

Subjects with insufficient data (either because a refraction could not be obtained or a visual acuity measurement was not taken) were not included in the statistical analysis. Table 1 describes the rejected measurements for each method of refraction.

<table>
<thead>
<tr>
<th>Table 1: Rejected Measurements and Apparent Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media Opacities</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Retinoscopy</td>
</tr>
<tr>
<td>Nidek</td>
</tr>
<tr>
<td>Retinomax</td>
</tr>
</tbody>
</table>

Valid results obtained using the three refraction techniques and the spectacle prescription, where applicable, were compared in four ways and are displayed in the listed tables:

1. Visual acuities and equivalent spheres of all successful measurements (Table 2)
2. Visual acuities and equivalent spheres of subjects with lens opacities of Grade 2 or worse (Table 3)

3. Visual acuities and equivalent spheres of subjects with any lens opacity (Table 4)

4. Visual acuity measurements on subjects having pupils smaller or equal to 2.5 mm (Table 5).

Analysis of variance (ANOVA) statistical tests were run on each of the categories with significance set at $p < 0.05$. When significance was found using ANOVA, a Scheffe post-hoc test was used to determine where the significance manifests. Significance level for the Scheffe test was set at $p < 0.10$. The Scheffe test sets more stringent levels for significance than other post-hoc tests; therefore, Scheffe advised using a significance value of $p < 0.10$ when he designed the test.\(^3\)

LogMAR visual acuities were obtained using the results from the four refraction techniques. The means and standard deviations are shown in Table 2, along with means and standard deviations for equivalent spheres.

| Table 2: Mean and SD of logMAR VA and Equivalent Sphere (ES) Obtained with Refraction Techniques |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Count | Mean VA | SD for VA | Mean ES | SD for ES |
| Prescription | 77 | .289 (20/39) | .222 | .965 | 1.748 |
| Retinoscopy | 77 | .321 (20/42) | .240 | 1.099 | 1.801 |
| Nidek | 77 | .228 (20/34) | .205 | 1.240 | 1.972 |
| Retinomax | 77 | .332 (20/43) | .254 | 1.438 | 1.772 |

Analysis of variance (ANOVA) statistical testing showed significance on visual acuity measurements with $p=.0001$. Using the Scheffe post-hoc test significant differences were found in the visual acuities taken with refractive error corrections from
the Nidek and Retinomax. Mean Nidek visual acuity was .228 (20/34); mean Retinomax visual acuity was .332 (20/43).

Equivalent sphere measurements showed significance at p=.0002 with ANOVA testing. The Scheffe post-hoc test did not show significance between any of the measurements. Mean equivalent sphere for the Nidek was 1.240 D and 1.438 D for the Retinomax.

Lens opacities were graded from 1 to 4 on all subjects (with 4 being the densest). Mean visual acuity and equivalent sphere were evaluated in all subjects who had opacities graded at 2 or worse. Results are shown in Table 3.

<table>
<thead>
<tr>
<th>Count</th>
<th>Mean VA</th>
<th>SD for VA</th>
<th>Mean ES</th>
<th>SD for ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription</td>
<td>.395 (20/50)</td>
<td>.192</td>
<td>1.080</td>
<td>1.367</td>
</tr>
<tr>
<td>Retinoscopy</td>
<td>.366 (20/47)</td>
<td>.240</td>
<td>1.358</td>
<td>1.478</td>
</tr>
<tr>
<td>Nidek</td>
<td>.270 (20/37)</td>
<td>.201</td>
<td>1.519</td>
<td>1.564</td>
</tr>
<tr>
<td>Retinomax</td>
<td>.417 (20/52)</td>
<td>.282</td>
<td>1.644</td>
<td>1.520</td>
</tr>
</tbody>
</table>

A value of p=.0065 for visual acuity suggests significance on ANOVA evaluation, but the Scheffe post-hoc test does not identify a significant difference between any of the measurements. Equivalent sphere measurements on these subjects did not show statistical significance by ANOVA.

Also evaluated were mean visual acuity and equivalent sphere on all subjects who had any opacity of the lens. Results are shown in Table 4.
Table 4: Mean and SD of logMAR VA and ES Obtained with Refraction Techniques on Subjects with Any Lens Opacity

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Mean VA</th>
<th>SD for VA</th>
<th>Mean ES</th>
<th>SD for ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription</td>
<td>54</td>
<td>.312 (20/41)</td>
<td>.205</td>
<td>.915</td>
<td>1.859</td>
</tr>
<tr>
<td>Retinoscopy</td>
<td>54</td>
<td>.330 (20/43)</td>
<td>.217</td>
<td>1.162</td>
<td>1.984</td>
</tr>
<tr>
<td>Nidek</td>
<td>54</td>
<td>.228 (20/34)</td>
<td>.205</td>
<td>1.242</td>
<td>1.997</td>
</tr>
<tr>
<td>Retinomax</td>
<td>54</td>
<td>.364 (20/46)</td>
<td>.260</td>
<td>1.485</td>
<td>1.825</td>
</tr>
</tbody>
</table>

ANOVA showed significance at p<.0001 for the visual acuity obtained in subjects with lens opacities. The Scheffe post-hoc test identified significant difference at p=.0204 between the Nidek mean visual acuity of .228 (20/34) and the Retinomax mean visual acuity of .364 (20/46).

Equivalent sphere showed ANOVA significance at p=.0008, but the Scheffe post-hoc did not show significance between any of the refractive techniques. Mean Nidek equivalent sphere is 1.242 D and mean Retinomax equivalent sphere is 1.485 D, showing nearly a 0.25 D more plus found by the Retinomax.

All eyes having pupils of 2.5 mm or smaller were evaluated by ANOVA for visual acuity (Table 5). Testing did not show statistical significance.

Table 5: Mean and SD of logMAR VA Obtained with Refraction Techniques on Subjects with Pupil Size Smaller Than or Equal to 2.5 mm.

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Mean VA</th>
<th>SD for VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription</td>
<td>20</td>
<td>.220 (20/33)</td>
<td>.170</td>
</tr>
<tr>
<td>Retinoscopy</td>
<td>20</td>
<td>.246 (20/35)</td>
<td>.184</td>
</tr>
<tr>
<td>Nidek</td>
<td>20</td>
<td>.193 (20/31)</td>
<td>.193</td>
</tr>
<tr>
<td>Retinomax</td>
<td>20</td>
<td>.245 (20/35)</td>
<td>.203</td>
</tr>
</tbody>
</table>
DISCUSSION

Rejected Measurements:

There was a total of twenty-eight rejected measurements. Of these twenty-eight, seven of the rejections were due to missing visual acuities. The remaining twenty-one were rejected because the autorefractor instruments were unable to provide data. The Nidek autorefractor had the most rejections with a total of eighteen. Twelve of these were because of postural constraints that inhibited proper patient positioning. The remaining six rejections were thought to be due to dense cataracts causing scattering of the light beam. The Retinomax only exhibited three rejected readings, again thought to be because of dense cataracts. Manual retinoscopy produced no rejections.

Visual Acuity:

Visual acuity utilizing all successful measurements was evaluated. Significance was found between visual acuity taken with refractive error measurements obtained from the Nidek and Retinomax. Mean Nidek visual acuity was approximately one line better than mean Retinomax visual acuity. When evaluating all subjects with eyes having any lens opacity, a statistical significance was also seen between the Nidek and the Retinomax. Mean visual acuity was, again, approximately one line better for the Nidek.

Subjects with pupil size smaller or equal to 2.5 mm or lens opacities graded at 2 or worse showed no statistical significant difference of visual acuity on post-hoc testing. This is thought to be due to the limited number of subjects in these categories. However, there is an identifiable trend for the Nidek to provide measurements that give improved acuity compared to those obtained from the Retinomax.
**Equivalent Sphere:**

When comparing equivalent spheres of all categories of measurements, the Retinomax mean equivalent sphere was more plus than the Nidek. Statistically, no significance was found between the equivalent sphere means of the measurements.

When comparing equivalent sphere to visual acuity, possible reasons for the significant difference in visual acuity with minimal difference in sphere could be due to cylinder power or axis differences, which were not evaluated statistically.

**CONCLUSIONS**

All methods of refraction tended to perform equally well with the geriatric population. The refractive error correction obtained from the Retinomax yielded one line lower visual acuity, but that instrument had fewer rejected measurements of the two autorefractors. Ease of measurement for the practitioner and the patient, and portability make the Retinomax a viable option for this population.
REFERENCES


