A RETROACTIVE STUDY COMPARING THE ACCURACY OF THE PEDIAVISION ASSESSMENT SOLUTION (PAS) PHOTO-SCREENER REFRACTION CAPABILITIES ON SPECIAL NEEDS PATIENTS AGAINST OTHER REFRACTION METHODS

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Abstract

Purpose: To compare the PediaVision Assessment Solution (PAS) hand held auto refractor against the Topcon KR-8900 auto refractor and the Canon RK- 3 auto refractor in accuracy in helping to finalize prescriptions during mass screenings of special needs patients.

Methods: Special Olympic athletes attending the summer games in Mount Pleasant, Michigan, were given a full comprehensive optometric vision screening over a three-day period. Over 1,000 athletes were given exams and 217 random exams were chosen to compare the accuracy of the PediaVision Assessment Solution to the Topcon KR-8900 and Canon RK-3 auto refractors in helping finalize prescriptions. If there were no final prescriptions written because of emmetropia, then those results were not counted. The older prescription was used to compare results if there was no change in the prescription. Three separate areas were evaluated: spherical power, cylinder power and cylinder axis. The pass/fail criteria were set as: +/-1.00 diopter off the final sphere, +/-0.75 diopters off the final cylinder power, and +/- 10 degrees off the final axis.

Results: Essentially all three auto refractors performed comparably. The PediaVision Assessment Solution had the lowest accuracy compared to the Topcon KR-8900 and the Canon RK-3. All three had low accuracy comparing the cylinder axis; however all three performed better in accuracy of the final cylinder power and sphere power.

Conclusion: For large screenings, especially if dealing with a demographic that may not be able to give you reliable responses, it is essential to have multiple ways to evaluate

refractive error. All three devices offer moderately accurate objective prescriptions that can aid in finalizing the spectacle prescription. The PediaVision Assessment Solution however offers additional screening tests that could further assist special needs screenings and help in possibly diagnosing abnormalities that may be otherwise missed.

TABLE OF CONTENTS

PAGE

APPENDIX

    A   PEDIAVISION ASSESSMENT SOLUTION (PAS) SPECIFICATIONS

    B   TOPCON KR-8900 SPECIFICATIONS

    C   CANON RK-3 SPECIFICATIONS

    D   COMPARISON RESULTS (upon request)

LIST OF FIGURES

FIGURE   PAGE

Introduction:

Special needs patients can suffer and/or present with a wide range of both physical and mental disorders. Some disorders may make communication difficult and can also affect attention. These issues can make an eye examination more challenging. Being able to rely mainly on an objective examination is extremely important when caring for these types of patients, especially when subjective answers are often unreliable.

During large group screenings, being efficient and accurate at the same time for every single patient can be difficult. However, it is still important to be as accurate as possible and give the best and the exact same care to every person every time. This retro study examines three different auto refractors and compares how accurate they are in aiding to determine the final prescription for special needs patients.

Retinoscopy is still the best and most accurate way to determine a final Rx[1], but it can take time and may not be the most efficient way to screen large volumes of people. The process for determining a final prescription has become more efficient with the development of auto refractors[1-4]. Auto refractors offer optometrists and others that are trained to utilize them, an accurate way to aid in finalizing the prescription, especially when screening larger populations[1-4].

The most prevalent childhood vision disorders are amblyopia, strabismus, anisometropia, and refractive errors such as myopia, hyperopia, and astigmatism[2-5]. These disorders are even more prevalent in the special needs population. Most auto refractors that are available today screen only for refractive error and may miss an eye turn or other anomalies that may not be so obvious on first glance.

1

The PediaVision Assessment Solution (PAS) (see Appendix A) was designed to help with large screenings in finding refractive errors, strabismus, amblyopia, and anisometropia[3, 4]. Being able to diagnose these different disorders early with one instrument saves time and allows for the early intervention needed for that particular patient. Currently there is very limited data on the accuracy of the PediaVision Assessment Solution in helping to determine a final prescription in the special needs population. This retroactive study was done to see how accurate the PediaVision Assessment Solution was compared to the Topcon KR-8900 (see Appendix B) and the Canon RK-3 (see Appendix C), being the more standard table top autorefractors, in helping to determine a spectacle Rx for this demographic.

Methods:

Auto Refractors

An auto refractor is a computer-controlled device that gives an <u>objective measurement</u> of a patient's refractive error[1]. The auto refraction method is fast, easy and non-invasive[1]. One eye is measured at a time and as the patient fixates on a target, several readings are taken which are averaged to give the optical prescription[1]. The patient does not have to give any verbal response, which is beneficial when your patient cannot give a reliable response or otherwise communicate.

The PediaVision Assessment Solution (PAS) is designed to be operated at a distance of one meter[6]. The patient fixates on a smiling face that lights up with a red nose. To also aid in fixation, the PediaVision Assessment Solution makes a sound to provide auditory

2

stimulation[6]. The Pediatric Assessment Solution screens for refractive errors, anisocoria, anisometropia, and corneal reflexes[6]. This auto refractor's spherical range is +5.00 to -7.00 diopters in 0.25 diopters steps[6]. The cylindrical range is +5.00 to -7.00 diopters in 0.25 diopter steps. Its axis range is 1 to 180° in 1° steps ± 15°. It can measure pupil sizes 4.0 to 8.0 mm and the time per measurement is 0.02 seconds.

The Topcon KR-8900 has the sphere power range of +25 D to -22 D (0.12 D/0.25 D), a cylinder power range of 0 D to ±10 D (0.12 D/0.25 D), and an axis range of 0° to 180° (in 1° or 5° steps)[7]. The minimal pupil diameter needed is 2.0mm[7]. The Topcon KR-8900 works by taking readings while the patient is fixating on a target at the end of the instrument (tube) after they are properly placed in the auto refractor.

The Canon RK-3 auto refractor keratometer is a compact and efficient unit with a wide measurement range similar to the Topcon KR-8900[8]. The Canon RK-3 can be also used to document lens opacity, PD, and corneal diameter[8]. The patient rests their chin and forehead on the rests and fixates on a target while the instrument determines their Rx.

Subjects

All athletes that compete in the summer Special Olympics in Mount Pleasant, Michigan, have the opportunity to have a free comprehensive vision screening. Over 1,000 athletes were screened (May of 2012) and out of those going through the screening, 217 were screened by either the Topcon KR-8900 and the PediaVision Assessment Solution or the Canon RK-3 and the PediaVision Assessment Solution. The athletes' ages ranged from 3 to 61 with the average age being 21. This sample included 135 males and 82 females. Age and gender were the only identifying data that was made available on the exam forms.

3

Screening Procedure

Each athlete went through a comprehensive vision screening without dilation, unless it was deemed necessary by one of the optometrist that was present at the screening. Optometrists, optometry students and trained volunteers from the Lions Club administered the different exam elements. The exam elements included the patient history, visual acuities, a cover test, EOM's, color vision, stereopsis, an external exam, an internal exam and refraction. In total, 217 athletes (or 434 eyes) were randomly screened with the PediaVision Assessment Solution and Topcon KR-8900 or the Canon RK-3.

Results:

Out of the 217 athletes that were screened, 64 of them had no final glasses prescription written. The total number of subjects that had a final prescription to compare readings from was 152, or a total of 304 eyes. Of the 152 people that were screened with two different auto refractors, 75 people (49.34%) were refracted with the Topcon KR-8900 and the PediaVision Assessment Solution and 77 people (50.65%) were refracted with the Canon RK-3 and the PediaVision Assessment Solution. For each group that was refracted, the final accuracy of each auto refractor was determined from the total number of eyes that were refracted per group. There were a total of 150 eyes for the PediaVision/Topcon group and a total of 154 eyes for the PediaVision/Canon group (see Figures 1 and 2).

4

FIGURE 1   Demographics

SEX	AGES	PRESCRIPTION
Male=135	Oldest= 67	No Rx=65 people
Female=82	Youngest=3	Required Rx=152 people

FIGURE 2   Total Number of People Screened in Group 1 and Group 2

PediaVision/Topcon	PediaVision/Canon
75 people	77 people
150 eyes	154 eyes

In the first group that was compared with the PediaVision/Topcon auto refractors, the accuracy for sphere power was 80.00% for the PediaVision Assessment Solution and 91.33% for the Topcon KR-8900. Accuracy of the PediaVision Assessment Solution for cylinder power was 67.33% and the Topcon KR-8900 was 71.33%. In comparing the PediaVision Assessment Solution and Topcon KR-8900, the accuracy for the cylinder axis was 60.00% for the PediaVision Assessment Solution and 56.66% for the Topcon KR-8900 (see Figure 3).

In the second group that was compared with the PediaVision/Canon auto refractors, the sphere power accuracy was 79.22% for the PediaVision Assessment Solution and 88.96% for the Cannon RK-3. Accuracy of the PediaVision Assessment Solution for cylinder power was 72.72% and the Cannon RK-3 was 75.32%. The PediaVision Assessment Solution had an accuracy of 57.14% and the Cannon RK-3 was 60.39% in cylinder axis (see Figure 3).

FIGURE 3   Results

Final Rx Accuracy	PediaVision	Topcon	PediaVision	Canon
Sphere	82.00%	91.33%	79.22%	88.96%
Cylinder Power	67.33%	71.33%	72.72%	75.32%
Axis	60.00%	56.66%	57.14%	60.38%

Discussion:

The PediaVision Assessment Solution was somewhat out performed in this study in all categories except for the cylinder axis against the Topcon KR-8900. The Topcon KR-8900 performed second best and the Cannon RK-3 was the most accurate in helping to determine the final optical/glasses prescription. Looking at all of the results, all three auto refractors that were used during the screening performed subpar in determining the final cylinder axis. They all however essentially had the same accuracy in finding the cylinder axis. The auto refractors had better results in determining the cylinder power. All three performed the best in accuracy of the final sphere power. A +/- 1.00 D buffer was used for the sphere power because of the nature of the subject group (special needs population) and cycloplegia was not used. All correlations were referenced to the final Rx given by the optometrists or their habitual Rx. The final Rx was based upon acuities, K readings, auto-refraction and retinoscopy.

The PediaVision Assessment Solution was specifically designed to help in large screenings of school aged children; however because this special type of "auto refractor unit" is able to pick up on many different ocular anomalies, it serves wonderfully for the special needs population. As stated earlier, the most prevalent childhood vision disorders are amblyopia, strabismus, anisocoria, anisometropia and refractive errors such as myopia, hyperopia, and astigmatism[2-5]. The PediaVision Assessment Solution was designed to help diagnose all of these issues. Even though the PediaVision Assessment Solution performed the weakest in helping determine a final glasses prescription, its main purpose is to aid as a screening device.

Mass screenings are usually performed in populations that may not have access to routine vision care and may not be aware that they even have a vision problem. Having a device that can quickly alert/detect to certain disorders that could be causing vision problems helps provide early care to an individual. Screenings are just that, they screen for anomalies and make proper referrals as needed. The Special Olympics in Mount Pleasant took the screening to essentially a complete exam, but other places or groups may not have the luxury of doing such a thorough screening. Because of the ease of use and relatively fast training period to operate the device, these auto refractors are key tools in helping make proper referrals during large screenings of any population.

Conclusion:

The best way to determine a patient's prescription is through cyloplegic refraction with retinoscopy performed by an optometrist. Cycloplegic auto refraction has also been shown to be more consistent and valid. Unfortunately during large screenings where hundreds of patients are seen in a short amount of time, it is not possible to cycloplege everyone. In these settings it is important to have many different options available when determining a final optical/spectacle prescription, such as lensometry, auto refraction, objective refraction and even subjective refraction. Ultimately auto refractors are just one tool that an optometrist uses in determining the final prescription.

As stated earlier, an auto refractor is just one tool in the optometrist's bag. If used properly, it can help in honing in on the true prescription or final glasses Rx. Each of the auto refractors that were used showed similar findings. If compared to more eyes

from this demographic, the findings would be even closer together. Even though the PediaVision Assessment Solution did not have the most accurate results, it is still a valuable screening device. The PediaVision Assessment Solution is able to pick up on or assess more issues with the eyes and help determine if further evaluation is needed on a particular patient. The other two auto refractors being fairly accurate in helping find the final prescription fall short in picking out any other anomalies of the eye. In choosing just one auto refractor to use during large screenings, the PediaVision Assessment Solution offers more than the Topcon RK-8900 or the Canon KR-3.

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Appendix A

PEDIAVISION ASSESSMENT SOLUTION (PAS) SPECIFICATIONS

12. Specifications

Measurements

Refraction binocular

Spherical range +5.00/-7.00 dpt in 0.25 dpt steps ± 0.25dpt

Cylindrical range +5.00/-7.00 dpt in 0.25 dpt steps ± 0.25dpt

Axis 1-180° in 1° steps ± 15°

Pupil size 4.0 – 8.0 mm in 0.1 mm steps ± 10%

Pupil distance mm in 1.0 mm steps ± 10 %

Time per measurement 0.02 s

Measuring distance 1 m ± 5 cm (3.3 feet)

Fixation target Warble sound

Measurement principal binocular, dynamic photosciascopy

Interfaces and standards

Interfaces 1 x VGA, 4 x USB and 1 x RJ-45

Printers Linux compatible

Standards EN 60601-1

Power

Medical Power Adapter

MES30B-3P1J

in 110V AC (50 - 60Hz), 0.8A

out 12V DC 2.5A

PediaVision S09

power consumption:

12VDC, 1A max.

Environmental requirements

Temperature operating 10 to 35 °C (50 to 92 °F)

storage 0 to 50 °C (32 to 122 °F)

Humidity operating 20 - 80 % not condensing

storage 10 - 85 % not condensing

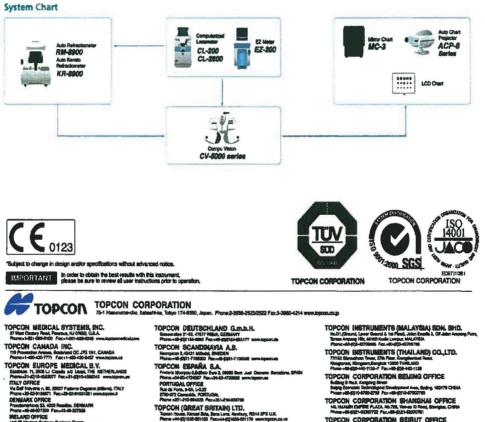- techsupport@pediavisio.com
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Appendix B

TOPCON KR-8900 SPECIFICATIONS

Specifications

Objective Refractometer Mode	RM-8900	KR-8900
Sphere range	-25D to +22D (0.12D/0.25D)	
Cylinder range	0D to ±10D (0.12D/0.25D)	
Axis range	0° to 180° (in 1° or 5° steps)	
Minimum measurable pupil diameter	ø2.0mm	
Corneal Curvature Mode		
Corneal curvature radius	—	5.00 to 10.00mm (0.01mm)
Refraction index	—	1.3375
Corneal refraction	—	67.5D to 33.75D (0.12D/0.25D)
Corneal astigmatism	—	0D to ±10D (0.12D/0.25 D)
Corneal astigmatism axial angle	—	0° to 180° (in 1° and 5° steps)
Others		
PD measurement range	20-85mm in 1mm step	
Output	RS-232C/ USB 1.1	

Other Specifications

	RM-8900	KR-8900
Dimensions	288(W) x 509(D) x 432-462(H)mm	
Weight	19.6 kg	
Power Supply	100-240V AC, 50/60Hz, 60VA	100-240V AC, 50/60Hz, 75VA

System Chart

CE 0123

*Subject to change in design and/or specifications without advanced notice.

IMPORTANT In order to obtain the best results with this instrument, please be sure to review all user instructions prior to operation.

TÜV SÜD

ISO 9001:2000 SGS

ISO 14001 JACO

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12

Appendix C

CANON RK-3 SPECIFICATIONS

canon rk-3 auto refractors - Bing Images

Appendix D

COMPARISON RESULTS (upon request)