COMPARATIVE EVALUATION OF THE ALLERGAN HUMPHREY 570 AND CANON RK-1 AUTOREFRACTORS: II OBJECTIVE AUTOREFRACTION IN PSEUDOPHAKES

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SUMMARY

Fifty patients (50 eyes) with posterior chamber intraocular lenses and a best corrected visual acuity of at least 6/12 were studied. The Allergan-Humphrey 570 (AH-570) and Canon RK-1 autorefractors were compared in terms of ease of operation, time taken and their accuracy relative to clinical refraction. Both the autorefractors were equally easy to operate but the AH-570 was quicker. The AH-570 had a higher percentage of eyes within 11° of clinically determined cylinder axis while the Canon RK-1 had a higher percentage of patients within 0.51 diopters of spherical equivalence, sphere power and cylinder power as determined by clinical refraction. This difference in the accuracy of objective autorefraction was not statistically significant; the clinical significance is uncertain.

In a recent study of objective autorefraction (AR) in normal subjects¹, it was found that the Allergan Humphrey 570 (AH-570) was quicker and more accurate in measuring ocular refraction than the Canon RK-1. The results obtained in normal subjects can not be extrapolated to pseudophakes since intraocular lenses (IOLs) can interfere with the accuracy of objective autorefractors²⁻⁵ by scattering the measuring infrared beam^{4,5}. The Canon RK-1 autorefractor has a special setting to improve the signal-to-noise ratio in the recording system while refracting pseudophakes. This instrument has been shown to provide acceptably accurate objective AR values in both anterior chamber⁶ and posterior chamber⁷ pseudophakes. Comparable information is not readily available for the AH-570 autorefractor, which does not have this special facility.

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This study was performed in posterior chamber pseudophakes, firstly to compare the AH-570 and Canon RK-1 in terms of ease and efficiency of operation, and secondly to examine whether the special IOL setting present in the Canon RK-1 gives greater accuracy.

PATIENTS AND METHODS

Instruments

The AH-570 and Canon RK-1 autorefractors were compared. The principle of objective AR, the facilities possessed and the actual measurement of refraction with these machines have been described in previous papers.^{1,5}

Patients and eyes

This prospective study was carried out between four months and nine months following extra-capsular or inter-capsular cataract extraction and attempted 'in the bag' implantation of a posterior chamber IOL. Patients with a visual acuity of at least 6/12 in the operated eye, prior to discharge from routine review, were recalled to take part in this study. Where both the eyes of the same patient met the eligibility criteria only the right eye was studied.

Methods

The methods adopted and statistical tests used have been described in our study of objective autorefraction in normal subjects¹.

RESULTS

Of the 52 patients who took part in the study, a valid AR was not possible in one, either with the AH-570 or the Canon RK-1. This was due to the inability of the patient to keep his eye focussed on the target. Objective AR was not possible in another patient with the AH-570 because of excessive light reflecting back to the instrument; Canon

RK-1 AR was possible in this patient. Both these patients were excluded from the study, leaving 50 patients for analysis.

The age of the patients included in the study ranged from 62 years to 89 years, with a mean of 74 (SD 9) years. There were 20 males and 30 females.

The ease of measurement for both the AH-570 and Canon RK-1 autorefractors ranged from 1 to 4 with a mean of 3.4 (SD 0.3) for the AH-570 and 3.3 (SD 0.3) for the Canon RK-1. This difference was not statistically significant ($p > 0.05$).

The time taken to perform objective AR with the AH-570 varied from 15 seconds to two minutes 47 seconds (167 seconds) with a mean of 32 (SD 23) seconds; in the Canon RK-1 this was between 22 seconds and one minute 44 seconds (104 seconds) with a mean of 45 (SD 17) seconds. This difference was statistically significant ($p < 0.002$).

In ten patients a cylinder value given by the Canon RK-1 was not found by CR. Another patient had no cylindrical error with either the Canon RK-1 or CR. These 11 patients were ascribed a cylinder value by the AH-570. None of these patients were considered when comparing the accuracy of the two autorefractors in determining the cylinder axis.

Table I shows the mean and standard deviation for the differences between AR and CR for the various refractive components. The spherical equivalent and the sphere power were more myopic and less hypermetropic on AR when compared to CR. There was no statistically significant differences between the AH-570 and Canon RK-1 for any of the refractive components studied ($p > 0.005$ for sphere power, $p > 0.1$ for spherical equivalence and cylinder power and $p > 0.5$ for cylinder axis).

The percentage agreement between AR and CR for the various refractive components is shown in Table II. The Canon RK-1 had a higher percentage of patients within 0.51 diopters (D) of CR in spherical equivalence, sphere power and cylinder power; the AH-570 had a higher percentage of patients within 11° of cylinder axis as determined by CR. However, these differences were not statistically significant ($p > 0.05$ for spherical equivalence and $p > 0.1$ for sphere power, cylinder power and cylinder axis).

DISCUSSION

The results of this study in posterior chamber pseudophakes are similar to the results of the previous study of

Table I. Mean differences between autorefraction (AR) and clinical refraction (CR) for the various refractive components

Refractive component	Mean differences* (SD)	
	AH-570	Canon RK-1
Spherical equivalence (D)	-0.12 (0.45)	-0.01 (0.37)
Sphere power (D)	-0.19 (0.49)	-0.02 (0.45)
Cylinder power (D)	0.23 (0.52)	0.11 (0.32)
Cylinder axis (degrees)	6.2 (7.1)	7.1 (7.5)

* The minus (-) sign indicates more myopia or less hypermetropia on autorefraction than by clinical refraction.

normal subjects¹. The AH-570 was quicker than the Canon RK-1, probably due to its fine-alignment system which automatically tracks small eye movements.

Both the autorefractors were notably more difficult to operate and slower in measuring ocular refraction in this series, compared to normal subjects¹. This may be attributed to: (i) the elderly age group of the patients studied with the associated reduction in patient co-operation, (ii) the presence of an IOL which interferes with objective AR by scattering the measuring infrared light, (iii) interference by the anterior capsule remnant in some cases of intercapsular cataract extraction.

Approximately 20% of the eyes studied gave a cylinder value on AR which was not required in the final prescription. This was less than the comparable figure of 40% seen in normal subjects¹, probably because more pseudophakes than normal subjects have a clinically significant cylinder value as a result of surgically-induced astigmatism.

The mean differences in the various refractive components and the degree of agreement between objective AR and CR failed to reveal any statistically significant difference between the accuracy of the AH-570 and Canon RK-1 in posterior chamber pseudophakes. However, the Canon RK-1 had a higher percentage of patients within 0.51 D of CR in spherical equivalence, sphere power and cylinder power than the AH-570 autorefractor. This was probably due to the optional IOL setting in the Canon RK-1 which improves the accuracy of AR in pseudophakes, unlike the AH-570 which does not have any special system to deal with the light reflected by IOL surfaces. In comparison with the AH-570, the Canon RK-1 had a lower percentage of patients within 11° of cylinder axis as determined by CR. The Canon RK-1 is known to have a higher error in axis determination^{1,2} probably because astigmatism is calculated from measurement in three fixed meridians. The clinical significance of these observations is difficult to interpret because objective AR values for patients following IOL implantation can only be considered as preliminary refraction values, requiring subjective verification. The AH-570 can provide subjective verification by the operator, using its internal lens

Table II. Percentage agreement between autorefraction (AR) and clinical refraction (CR) for the various refractive components

Refractive component	Agreement between AR and CR (in cumulative %)		
	± 0.25D	± 0.5D	± 1.0D
Spherical equivalent (n = 50)			
AH-570	50	76	92
Canon RK-1	62	90	100
Sphere power (n = 50)			
AH-570	50	68	94
Canon RK-1	60	82	100
Cylinder power (n = 50)			
AH-570	52	66	86
Canon RK-1	56	80	94
	±5°	±10°	±20°
Cylinder axis (n = 39)			
AH-570	51	82	100
Canon RK-1	36	71	95

system. This facility is not available on the Canon RK-1. The accuracy of subjective verification with the AH-570 in posterior chamber pseudophakes is currently under investigation.

Both the AH-570 and the Canon RK-1 autorefractors can be operated by nursing staff providing objective AR values for post-operative patients with lens implants. This results in an appreciable saving of the clinician's time. All our post-operative patients are now routinely autorefracted by a nurse when they attend our outpatient clinic following their cataract surgery with IOL implantation.

Key words: Autorefraction, Intra-ocular lens, Pseudophakia, Refraction-automated.

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