Comparison of Autorefractometer, Retinoscope and Subjective Method in Myopic and Hypermetropic Patients

Anita Ganger[1], Saroj Bala[2], Inderjit Kaur[3], Prempal Kaur[4], Satpal[5]

ABSTRACT

Introduction: Automatic refractors have become more important in recent years because of the busy clinical schedule of ophthalmologists and increasing faith of patients in sophisticated mechanical devices. The present study was undertaken to compare the results of autorefractometer testing, retinoscopy and subjective refraction testing using cycloplegia in in myopic and hypermetropic patients.

Material and Methods: The present study comprised of 100 binocular patients who reported for refractive problems. Patients were examined by both the methods i.e. by objective refraction testing (autorefractometer testing and retinoscopy) and subjective refraction. The results were compared and statistical analysis was carried out using Chi-square test with $p \leq 0.05$.

Results: The present study observed that in hypermetropic patients, while calculating calculating spherical error under cycloplegic conditions, AR readings do not correlated with RE and SB whereas retinoscopic findings were correlated well with subjective correction. In hypermetropes with the excessive use of accommodation at the time of refraction refractive error values get altered where as when we use cycloplegic accommodation relaxed and correct refractive error can be determined. In myopic patients there was no significant difference of mean and standard deviations values between all the three parameters by using autorefractometer, retinoscopy and subjective method after using cycloplegic.

Conclusion: Autorefractometer is an invaluable aid for screening large number of cases in busy ophthalmological clinics. Manual retinoscopy is still the most accurate technique to estimate refractive status and gives better starting point for subjective refraction.

Keywords: Autorefractometer, Retinoscopy, Subjective Method, Vision

INTRODUCTION

Accommodation interferes with accurate diagnosis of the latent refractive errors. Retinoscopy offers accurate measurements of accommodative response, while an autorefractometer can predict the accommodative system activation especially in children.[1] Cycloplegic retinoscopy and subjective refraction remain the gold standard for measuring refractive status in children. However, cycloplegia is limited by the time needed to achieve full cycloplegia, its association with patient discomfort, inconvenience, and additional cost. More recently, autorefractors without cycloplegia have become widely used to obtain the objective refractive status of children in vision screening, clinical practice, or in research settings such as epidemiologic surveys, and clinical trials.[2]

Automatic refractors have become more important in recent years because of the busy clinical schedule of ophthalmologists and increasing faith of patients in sophisticated mechanical devices. Many such refractometers, subjective and objective, are now available, with steadily improving designs and greater claims to accuracy.[3] The present study was undertaken to compare the results of autorefractometer testing, retinoscopy and subjective refraction testing -

MATERIAL AND METHODS

The present study comprised of 100 binocular patients (200 eyes) randomly selected among patients visiting the outpatient Department of Ophthalmology, for refractive problems. Patients were examined by both the methods i.e. by objective refraction testing (autorefractometer testing and retinoscopy) and subjective refraction with and without cycloplegia. For convenience the method of refraction was abbreviated as follow: SB-subjective method, AR- autorefractometer, RE- retinoscopy, SP- sphere, CY- cylinder, SE- spherical equivalence, NC- noncycloplegic refraction and C- cycloplegic refraction.

Patients aged 7-10 years with visual acuity <6/12 were included in the study. Patients with decreased visual acuity due to causes other than refractive disorders were excluded from the study.

Ethical clearance was obtained from the college ethical committee and written consent of patients or guardians if age less than 18 years was obtained after explaining the procedure.

Each eye was examined first by autorefractometer and then by retinoscopy and then subjective refraction was done under effect of cycloplegia. 2 drops of cyclopentolate 1% in each eye were put 5 minutes apart and waited for 30 minutes. In those cases where pupil was not dilated one drop in each eye was instilled again and waited for 5 minutes and even if pupil was not dilated yet such cases were excluded from the study.

The whole procedure was done by following steps:

1. Refraction testing by autorefractometer. Three readings of autorefractometer were taken and then average of these was taken as final reading.
2. Refraction testing by retinoscopy method was done.
3. Subjective refraction testing was done as follows:
   a) Initial starting refraction was determined
   b) Refinement of sphere for right eye was done
   c) Refinement of cylinder axis for right eye was done
   d) Refinement of cylinder power for right eye was done

[1]Senior Research Associate, Dr. R. P. Center for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi, [2]Assistant Professor, [3]Ex Professor, [4]Associate Professor, [5]Ex Professor, Department of Ophthalmology, Government Medical College Amritsar, India

Corresponding author: Dr. Anita Ganger, Senior Research Associate, Dr. R. P. Center for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi-110029, India

How to cite this article: Anita Ganger, Saroj Bala, Inderjit Kaur, Prempal Kaur, Satpal. Comparison of autorefractometer, retinoscope and subjective method in myopic and hypermetropic patients. International Journal of Contemporary Medical Research 2017;4(3):740-743.

e) Rechecking of sphere for right eye was done
f) Same procedure was repeated for left eye.

STATISTICAL ANALYSIS

The results of subjective refraction testing were compared with the readings from autorefractometer and retinoscopy and statistical analysis was carried out using Chi-square test with $p \leq 0.05$.

RESULTS

As the refractive errors of two eyes in all patients were related, so only data from 100 right eyes of patients were analyzed.

Patients were divided in two age groups to find out age wise distribution of type of refractive error. In group1 patients were < or equal to 10 years and in group2 patients were>10 years of age. Out of 100 patients, 46 were in group 1 and 54 were in group 2. In group1 among 46 patients 9 were myopic and 37 were hypermetropic. In group 2 among 54 patients 30 were myopic and 24 were hypermetropic. p value was <0.001 which was statistically significant (table 1).

Firstly results of spherical errors given by autorefractometer and subjective method were compared 33 myopic patients had mean and standard deviation of differences -0.12±0.78 resulted in p value of 0.35 whereas 59 hypermetropic patients had mean and standard deviation of differences 0.02±0.14 resulted in p value of 0.023*. When results of spherical errors given by retinoscopy and subjective method were compared 33 myopic patients had mean and standard deviation of differences -0.15±0.16 resulted in p value of 0.601, whereas 59 hypermetropic patients had mean and standard deviation of differences 0.39±0.24 resulted in p value of 0.279. When results of spherical errors given by autorefractometer and retinoscopy and were compared 33 myopic patients had mean and standard deviation of differences -0.14±0.82 resulted in p value of 0.320 whereas 59 hypermetropic patients had mean and standard deviation of differences 0.155±0.57 resulted in p value of 0.011*.

Secondly results of cylindrical errors given by autorefractometer and subjective method were compared 24 myopic patients had mean and standard deviation of differences -0.13±0.62 resulted in p value of 0.306 whereas 03 hypermetropic patients had mean and standard deviation of differences 0.23±0.35 resulted in p value of 0.373.When results of cylinderical errors given by retinoscopy and subjective method were compared 22 myopic patients had mean and standard deviation of differences -0.03±0.15 resulted in p value of 0.277 whereas in 03 hypermetropic patient had mean and standard deviation of differences 0.167±0.144 and resulted in p value of 0.184. When results of cylinderical errors given by autorefractometer and retinoscopy and were compared 22 myopic patients had mean and standard deviation of differences -0.18±0.59 resulted in p value of 0.165 whereas 03 hypermetropic patients had mean and standard deviation of differences 0.390±0.24 resulted in p value of 0.105.

Thirdly results of spherical equivalence given by autorefractometer and subjective method were compared 39 myopic patients had mean and standard deviation of differences -0.22±0.77 resulted in p value of 0.083 whereas 61 hypermetropic patients had mean and standard deviation of differences 0.022±0.454 resulted in p value of 0.696.When results of spherical equivalence errors given by retinoscopy and subjective method were compared 39 myopic patients had mean and standard deviation of differences -0.03±0.16 resulted in p value of 0.211 whereas in 61 hypermetropic patient had mean and standard deviation of differences -0.01±0.14 resulted in p value of 0.354. When results of spherical equivalence errors given by autorefractometer and retinoscopy were compared 39 myopic patients had mean and standard deviation of difference -0.25±0.80 resulted in p value of 0.058 whereas 61 hypermetropic patients had mean and standard deviation of difference 0.04±0.46 resulted in p value of 0.500 (table 2).

DISCUSSION

In the present study, hundred patients were tested with autorefractometer, retinoscope and subjective method after using cycloplegic. The age of the patients taken up in this study ranged between 7-14 years. The children of this age group were taken up simply because of the reason that they could follow the instructions of the examiner more easily as compared to

Age (Years)	Myopic	Hypermetropic	x^2 value	P value	Significance
< = 10 years	9	37	13.525	<0.001	Highly Significant
> 10 years	30	24			
Total	39	61			

Table-1: Age wise distribution of refractive error.

Parameter			Myopic cases			Hypermetropic cases		
			N	Mean ± SD of Difference	P value	N	Mean ± SD of Difference	P value
Cycloplegic	Spherical	Autoref. Vs Subjective	33	-0.12 ± 0.78	0.349	59	0.155 ± 0.57	0.023*
		Retinoscopy Vs Subjective	33	-0.15 ± 0.16	0.601	59	-0.02 ± 0.14	0.279
		Autoref. Vs Retinoscopy	33	-0.14 ± 0.82	0.320	59	0.176 ± 0.52	0.011*
	Cylindrical	Autoref. Vs Subjective	24	-0.13 ± 0.62	0.306	03	-0.23 ± 0.35	0.373
		Retinoscopy Vs Subjective	22	-0.03 ± 0.15	0.277	03	0.167 ± 0.144	0.184
		Autoref. Vs Retinoscopy	22	-0.18 ± 0.59	0.165	03	-0.390 ± 0.24	0.105
	Spherical Equivalent	Autoref. Vs Subjective	39	-0.22 ± 0.77	0.083	61	0.022 ± 0.454	0.696
		Retinoscopy Vs Subjective	39	0.03 ± 0.16	0.211	61	-0.017 ± 0.145	0.354
		Autoref. Vs Retinoscopy	39	-0.25 ± 0.80	0.058	61	0.040 ± 0.463	0.500

Table-2: Comparative analysis of autorefractometer, retinoscope and subjective methods in myopic and hypermetropic cases

smaller children while being tested on autorefractometer (AR), retinoscope (RE) and subjective (SB) method.

Uras R et al[4] conducted a study to estimate the agreement between an autorefractor and retinoscopy with subjective refraction. Measurements of autorefraction and retinoscopy were performed on 192 right eyes from 192 healthy young adults and compared with subjective refraction. These measurements were performed without cycloplegia. A comparison of the autorefractor and subjective refraction results showed that for the mean spherical equivalent (M), the autorefractor yields more negative values, the autorefractor yielded more positive values than the subjective ones and (the autorefractor results were more negative and the result confirmed that when performed by an experienced clinician, retinoscopy was more accurate than automatic refraction, giving a better starting point to noncycloplegic refraction. Study done by Bullimore MA et al[5] evaluated the accuracy of autorefraction using three autorefractors comparing to subjective refraction in diagnosing refractive error in children in a cross-sectional study on 117 children was done and the study concluded that under noncycloplegic conditions, all three autorefractors had a tendency towards minus over correction in children resulting in over diagnosis of myopia. However, autorefractors were accurate under cycloplegic conditions. Tongue AC[6] compared the accuracy of readings of RMA-3000 autorefractor with traditional retinoscopy and found that from 69 right eyes with negative sphere they observed that the sphere power was significantly higher in cycloplegic autorefraction than in noncycloplegic autorefraction. From 73 normal and hyperopic right eyes they observed that sphere power was significantly lower in noncycloplegic autorefraction than cycloplegic autorefraction and traditional retinoscopy. So they concluded that the use of autorefractometer in children (in whom accommodation is more active than older patients) without cycloplegia may underestimate the actual hyperopia and overestimate the actual myopia. Hence, in the present study, comparison was carried out under cycloplegic conditions

The present study observed that in hypermetropic patients, in calculating spherical error under cycloplegic conditions, AR readings do not correlated with RE and SB whereas retinoscopic findings were correlated well with subjective correction. In children with the excessive use of accommodation at the time of refraction refractive error values get altered where as when we use cycloplegic accommodation relaxed and correct refractive error can be determined. In myopic patients there was no significant difference of mean and standard deviations values between all the three parameters by using autorefractometer, retinoscopy and subjective method after using cycloplegic.

Prabhakar SK[1] conducted a study to find correlation of the accommodative effort with the dynamic refraction in emmetropic children, and revealed that the performance of autorefractor was comparable to retinoscopy accuracy. Rotsos T et al[3] conducted a study to compare the accuracy of readings of the autorefractometer and traditional retinoscopy as a means of determining the approximate subjective refraction in children after cycloplegia. The use of the autorefractometer in children (in whom accommodation is more active than older patients) without cycloplegia may underestimate the actual hyperopia and overestimate the actual myopia. Manual retinoscopy is still the most accurate technique to estimate refractive status in children.

Rosenfield M et al[7] determined the accuracy of measurement by the Nikon Retinomax handheld autorefractor as compared to subjective refraction and cycloplegic retinoscopy. They found that accuracy of measurements of handheld autorefractor in children is high under cycloplegia. Without cycloplegia, a minus overcorrection of more than -2.0 D was observed in 24% of cases. Hence, the study concluded that it is necessary to check and improve the displayed values by subjective refraction or retinoscopy. The results also concluded that optometrists and ophthalmologists should check the binocular refraction balance during final steps of the subjective refraction procedure, because spherical error made by an autorefractor in both eyes individually may add up binocularly in an undesirable manner.

Verboven L et al[8] compared the speed and accuracy of the Nidek ARK-900 objective refractor with standard retinoscopy and found that 96% of children read the 20/30 line perfectly with the results from objective refractor compared to 88% with retinoscopy. The study concluded that Nidek ARK-900, representing the third generation of objective refractors, is comparable and superior to retinoscopy in accuracy in children, can be easily run by ophthalmic technician and therefore eliminates the physician's examination time required for retinoscopy. Williams C et al[9] conducted a study to determine the accuracy of autorefractometer and found that autorefractometer underestimated hypermetropic refractive errors when used without cycloplegia. However, it was at least as good a screening device as other similar instruments, especially when judged by its ability to detect anisometropia and the repeatability of the results. Choong YF et al[2] also reported that autorefractors were accurate under cycloplegic conditions.

Thus, power refractor may be a useful device for screening small children and handicapped people because of the one meter observing distance. For a precise refraction especially in children a retinoscopy under cycloplegic conditions is still necessary.[10-12]

CONCLUSION

Autorefractometer is an invaluable aid for screening large number of cases in busy ophthalmological clinics. But it should not replace the art of clinical refraction testing and should be used with great caution especially in younger patients in whom accommodation is more active because real hypermetropia may be unrevealed. Manual retinoscopy is still the most accurate technique to estimate refractive status in children and gives better starting point for subjective refraction.

REFERENCES

1. Prabhakar SK. Study on accommodation by autorefraction and dynamic refraction in children. J Optom. 2014;7:193–202.
2. Choong YF, Chen AH, Goh PP. A Comparison of Autorefraction and Subjective Refraction With and Without Cycloplegia in Primary School Children. Am J Ophthalmol. 2006;142:68–74.
3. Rotsos T, Grigoriou D, Kokkolaki A, Manios N. A comparison of manifest refractions, cycloplegic refractions and retinoscopy on the RMA-3000 autorefractometer in children aged 3 to 15 years. Clin Ophthalmol. 2009;3: 429–431.
4. Uras R, Belfort R, Hofling-Lima AL, Martins EL.

Automatic objective refraction and clinical refraction - a comparative analysis Arq Bras Oftalmol. 2001;64:33-8.
5. Bullimore MA, Fusaro RE, Adams CW. The repeatability of automated and clinician refraction. Optom Vis Sci. 1998;75:617-22.
6. Tongue AC. Refractive error in children. Pediatr Clin North Am. 1987;34:1426-1437.
7. Rosenfield M, Chin NN. Repeatability of subjective and objective refraction. Ophthalmol Vis Sci. 1995;72:577-579.
8. Verboven L, Missoten L, Possibilities and limitations of refraction measurement by an automatic refractor. Bull Sec Belge Ophthal. 1982;201:65-70.
9. Williams C, Lumb R, Harvey I, Sparrow JM. Screening for refractive errors with the Topcon PR2000 Pediatric Refractometer. Invest Ophthalmol Vis Sci. 2000;41:1031-7.
10. Isenberg SJ, Del Signore M, Madani-Becker G. Use of the HARK autorefractor in children Am J Ophthalmol. 2001;131:438-41.
11. Abraham Ipe, Priyanka Shibu, Rohith Skariah. Prevalence of refractive errors and the extent of correction possible with conservative methods, among patients visiting a tertiary care hospital in South Kerala. International Journal of Contemporary Medical Research. 2016;3:2754-2756.
12. Puspendu Das, Ruma Das, Praveer Kumar Shrivastava, Abhisek Mondal. A clinical study on the correlation between axial length, intraocular pressure and central corneal thickness in myopic eyes. International Journal of Contemporary Medical Research. 2016;3:1141-1144.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 03-03-2017; **Accepted:** 02-04-2017; **Published:** 11-04-2017