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ORIGINAL ARTICLE

COMPARISON OF SUBJECTIVE AND OBJECTIVE REFRACTION IN CHILDREN WITH AND WITHOUT USING CYCLOPLEGICS

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ABSTRACT:

Aim and objectives: The present study was undertaken to compare subjective and objective (autorefractometer and retinoscopy) methods of refraction, before and after using cycloplegics. **Material and Methods:** The present prospective study, comprised 200 eyes of 100 patients with visual acuity <6/12 and patients having asthenopic symptoms. The results of subjective refraction testing were compared with the readings from auto refractometer and retinoscopy with and without the use of cycloplegia. Statistically data was compared using chi-square test and p value ≤0.005 was considered significant. **Results:** The present study found that in hypermetropic patients mean and standard deviations of spherical error and spherical equivalence were very different when calculated before using cycloplegic as compared to post cycloplegic values, where as cycloplegia had no significant effect on values of cylindrical error. They were same with all the three methods both before and after using cycloplegic. 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 both before and after using cycloplegic. **Conclusion:** Non-cycloplegicre fraction cannot be considered as a reliable method to assess the refractive error in children.

Keywords: Cycloplegia; Refractive error; Retinoscopy

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INTRODUCTION

Refractive error is one of the most common causes of visual impairment around the world and the second leading cause of treatable blindness. Visual impairment can have a significant impact on a child's life in terms of education and development hence it is important that effective strategies be developed to eliminate this easily treated cause of visual impairment at the earliest.[1]

Emmetropia is a condition where in parallel rays of light are focused on the retina when the accommodation is at rest. On the other hand if the light rays are not focused on the retina but these are focused behind or in front of the retina, the person is unable to see the objects clearly and the condition is called ammetropia. When the rays of light are focused behind the retina the condition is called hypermetropia and when the rays are focused in front of the retina the condition is called myopia. Myopia and hypermetropia are further divided into various types namely axial, curvatural and index depending upon the causative factor involved. The extent to which the refractive system of the eye is faulty in focusing the rays of light on retina is called error of refraction.[2]

The gold standard of objective refraction is retinoscopy although the newer autorefractometers do give comparable results. Autorefractometers induce some amount of proximal convergence, and thus, in turn produce some accommodation, in spite of the cycloplegia, leading to a mild undercorrection of the hypermetropia. Also, in young, uncooperative children, it is difficult to convince the child to place the head on to the autorefractometer, although hand-held autorefractometers help overcome this problem.[3]

When the first autorefractor was developed over 30 years ago, many optometrists were concerned about the impact such devices would have on the profession. Today, those concerns are all but forgotten, with the eye care profession positively embracing objective refraction technology.

The reason for its increasing popularity is primarily that automated refraction devices offer speed, reasonable

accuracy and repeatability. Indeed, there are publications to support the notion that autorefractors are more accurate and repeatable than retinoscopy.[4]However, one should not forget that retinoscopy provides certain information not provided by conventional autorefractors. For example, it informs the practitioner about media opacities and significant ocular aberration.

It is important to accurately measure the refractive errors for prevention of amblyopia in children. Vision screening in childhood aims to detect several disorders resulting in vision defects. Because of the large working distance (approximately 1 m), photorefraction is applicable to children who are afraid of examinations and disabled patients. It has advantageous in view of short examination duration and binocular measurement.[5]
Accepting that differences between cycloplegic and noncycloplegic are only due to accommodative response, so when performed by an experienced clinician, retinoscopy is more reliable method to obtain objective start point for refraction under noncycloplegic condition. However, cycloplegia is limited by the time needed to achieve full cycloplegia, its association with patient discomfort, inconvience and additional cost.[6]
The present study was undertaken to compare subjective and objective (autorefractometer and retinoscopy) methods of refractionbefore and after using cycloplegics.

MATERIAL AND METHODS

The present prospective study comprised 200 eyes of 100 patients, with age range of 7 to 14 years. The study included randomly selected subjects visiting the outpatient department of Ophthalmology, Government Medical College Amritsar for refractive problems. The study was conducted only after explaining the nature of the study and obtaining the written consent of parents or guardian. Inclusion criteria of the study was patients aged between 7 and 14 years with visual acuity <6/12 and patients having aesthenopic symptoms. Patients with hazy media, amblyopia, strabismus or any abnormality of pupil were excluded from the study.
T**able 1:** Gender wise distribution of refractive error

100 binocular patients (200 eyes) were examined by both the methods i.e. by objective refraction testing (autorefractometer testing and retinoscopy) and subjective refraction with and without cycloplegia. Autorefractometer was placed in a dimly lit, cool, and dust free room. The machine was ready for use as soon as the power was on. Patient was seated comfortably and the eye to be refracted was aligned in accordance with the eye alignment mark monitored on the monitor screen with the help of joy stick. For getting accurate reading of refractive error, proper alignment, absence of movement of eye and clear media were the main prerequisites.
Each eye was examined first by autorefractometer and then by retinoscopy and then subjective refraction was done. After that, the same procedure was repeated under effect of cycloplegia. As a cycloplegic cyclopentolate 1% eye drops were used. It was short acting cycloplegic and so its effect lasted for 18 hours. Two drops of cyclopentolate were instilled 5 minutes apart. Peak effect came in 30 minutes. Both objective and subjective refraction were done afterwards.
Three readings of autorefractometer were taken and then average of these was taken as final reading. The results of subjective refraction testing were compared with the readings from autorefractometer and retinoscopy with and without the use of cycloplegia. Statistically data was compared using chi-square test with p value ≤0.005 was considered significant.

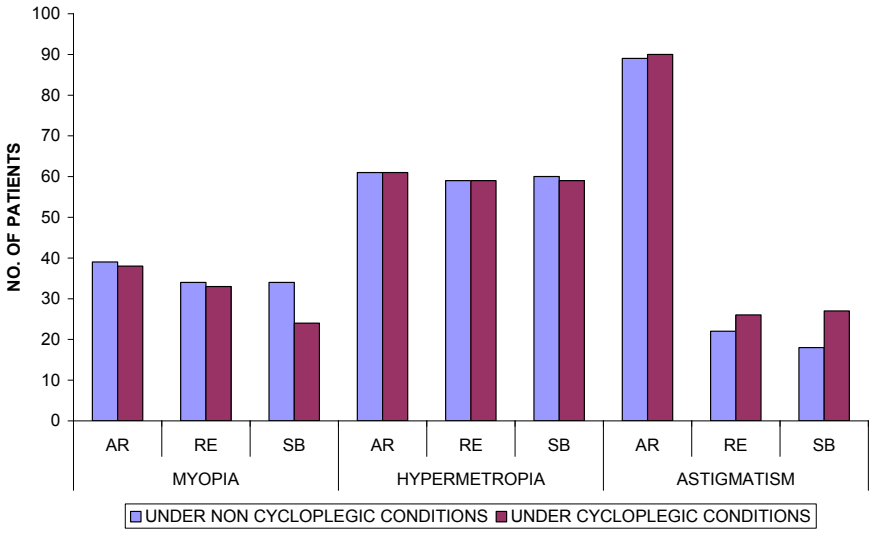
RESULTS

For convenience the method of refraction will be abbreviated as follow:
*SB-subjective method, AR- autorefractometer, RE-retinoscopy, SP- sphere, CY- cylinder, SE- spherical equivalence, NC- noncycloplegic refraction and C-cycloplegic refraction
As the refractive errors of two eyes in all children were related, so only data from 100 right eyes of children were analyzed. Table 1 shows gender wise distribution of refractive error.

Gender	Myopic	Hypermetropic	Total
Males	28	26	54
Females	11	35	46
Total	39	61	100

Table 2: Degree of difference between data for various refractive errors by autorefractometer, retinoscopy and subjective method

	MYOPIA			HYPERMETROPIA			ASTIGMATISM		
	AR	**RE**	**SB**	**AR**	**RE**	**SB**	**AR**	**RE**	**SB**
Under non cycloplegic conditions	39	34	34	61	59	60	89	22	18
Under cycloplegic conditions	38	33	32	61	59	59	90	26	27

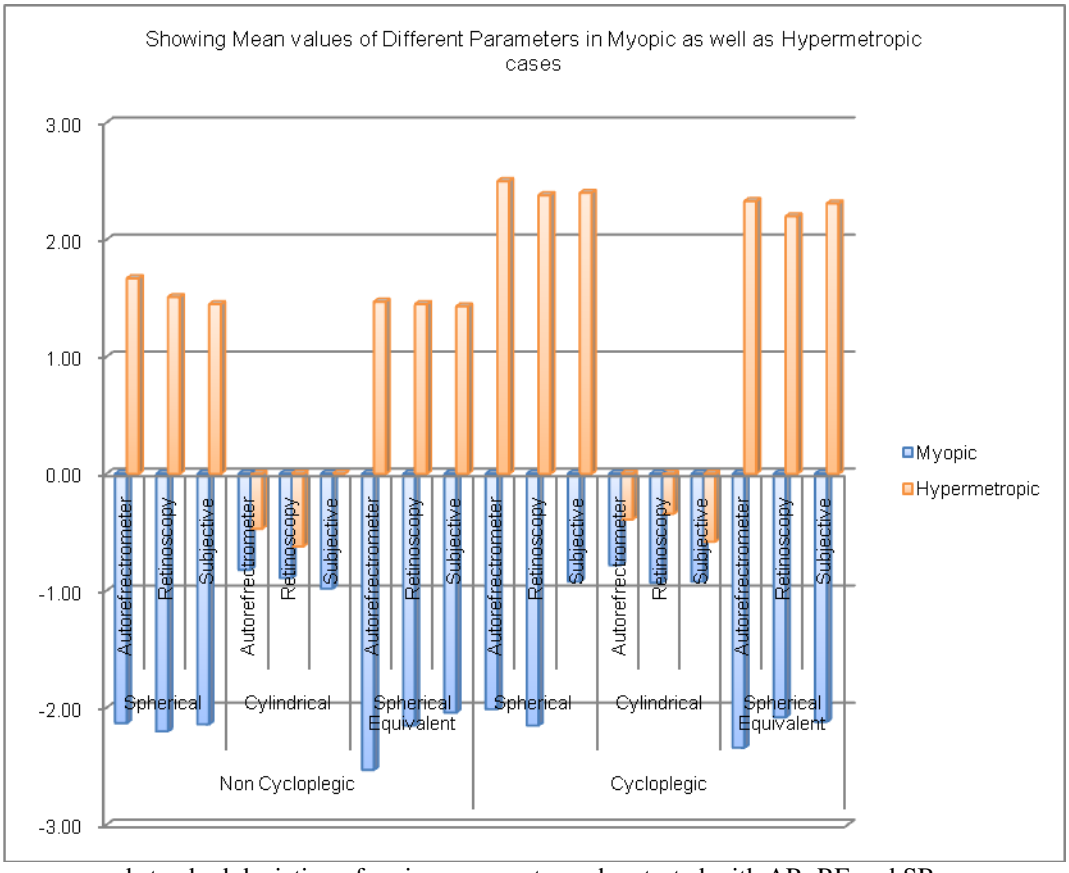


Graph 1: Degree of difference between data for various refractive errors by AR, RE and SB

Table 3: Showing mean and standard deviation of various parameters when tested with AR, RE and SB

Parameter			Myopic		Hypermetropic	
			N	**Mean ± SD**	**N**	Mean ± SD
Non Cycloplegic	Spherical	Autorefrectometer	39	-2.13 ± 1.40	61	1.67 ± 0.87
		Retinoscopy	34	-2.20 ± 0.97	59	1.51 ± 0.80
		Subjective	34	-2.14 ± 1.10	60	1.45 ± 0.87
	Cylindrical	Autorefrectometer	38	-0.82 ± 0.85	51	-0.47 ± 0.46
		Retinoscopy	20	-0.89 ± 0.79	02	-0.62 ± 2.29
		Subjective	14	-0.98 ±0.91	04	0.00 ± 0.67
	Spherical Equivalent	Autorefrectometer	39	-2.53 ± 1.30	61	1.47 ± 0.91
		Retinoscopy	39	-2.15 ± 0.97	61	1.45 ± 0.86
		Subjective	39	-2.04 ± 1.08	61	1.43 ± 0.88
Cycloplegic	Spherical	Autorefrectometer	38	-2.01 ± 1.55	61	2.50 ± 1.00
		Retinoscopy	33	-2.15 ± 0.93	59	2.38 ± 1.09
		Subjective	32	-2.17 ± 0.95	59	2.40 ± 1.10
	Cylindrical	Autorefrectometer	38	-0.78 ± 0.88	52	-0.39 ± 0.44
		Retinoscopy	22	-0.93 ± 0.85	04	-0.34 ± 1.45
		Subjective	24	-0.92 ± 0.85	03	-0.58 ± 1.66
	Spherical Equivalent	Autorefrectometer	39	-2.34 ± 1.43	61	2.33 ± 1.03
		Retinoscopy	39	-2.08 ± 0.98	61	2.20 ± 1.16
		Subjective	39	-2.12 ± 1.02	61	2.31 ± 1.17

Out of 100 eyes under non cycloplegic conditions autorefractometer showed myopia in 39 eyes, hypermetropia in 61 eyes and astigmatism in 89 eyes. Retinoscopy showed myopia in 34 eyes, hypermetropia in 59 eyes and astigmatism in 22 eyes. Subjective method showed myopia in 34 eyes, hypermetropia in 60 eyes and astigmatism in 18 eyes. On the other hand under cycloplegic conditions autorefractometer showed myopia in 38 eyes, hypermetropia in 61 eyes and astigmatism in 90 eyes. Retinoscopy showed myopia in 33 eyes, hypermetropia in 59 eyes and astigmatism in 26 eyes. Subjective method showed myopia in 32 eyes, hypermetropia in 59 eyes and astigmatism in 27 eyes (table 2 and graph 1).



Graph 2: Showing mean and standard deviation of various parameters when tested with AR, RE and SB

Under noncycloplegic conditions: Out of 100 patients autorefractometer showed spherical error of myopic type in 39 patients whose mean and standard deviation was -2.13±1.40 where as spherical error of hypermetropic type was found in 61 cases whose mean and standard deviation was 1.67±0.87. Retinoscope showed spherical error of myopic type in –34 patients whose mean and standard deviation was -2.20±0.97 where as spherical error of hypermetropic type was found in 59 cases whose mean and standard deviation was 1.51±0.80. Subjective method showed spherical error of myopic type in 34 patients whose mean and standard deviation was-2.14±1.10 where as spherical error of hypermetropic type was found in 60 cases whose mean and standard deviation was 1.45±0.87.

Out of 100 patients autorefractometer showed cylinderical error of myopic type in 38 patients whose mean and standard deviation was -0.82±0.85 where as cylinderical error of hypermetropic type was found in 51 cases whose mean and standard deviation was –0.47±0.46. Retinoscope showed spherical error of myopic type in 20 patients whose mean and standard deviation was -0.89±0.79 where as cylindrical error of hypermetropic type was found in 02 cases whose mean and standard deviation was 0.62±2.29. Subjective method showed cylinderical error of myopic type in 14 patients whose mean and standard deviation was -0.98±0.91 whereas cylinderical error of hypermetropic type was found in 04 cases whose mean and standard deviation was 0.00±0.67.

Under cycloplegic conditions, out of 100 patients autorefractometer showed spherical error of myopic type in 38 patients whose mean and standard deviation was -2.01±1.55 where as spherical error of hypermetropic type was found in 61 cases whose mean and standard deviation was 2.50±1.00. Retinoscope showed spherical error of myopic type in 33 patients whose mean and standard deviation was -2.15±0.93 where as spherical error of hypermetropic type was found in 59 cases whose mean and standard deviation was 2.38±1.09. Subjective method showed spherical error of myopic type in 32 patients whose mean and standard deviation was –2.17±0.95 where as spherical error of hypermetropic type was found in 59 cases whose mean and standard deviation was 2.40±1.10.

Out of 100 patients autorefractometer showed cylinderical error of myopic type in 38 patients whose mean and standard deviation was -0.78±0.88 where as cylinderical error of hypermetropic type was found in 52 cases whose mean and standard deviation was –0.39±0.44. Retinoscope showed spherical error of myopic type in 22 patients whose mean and standard deviation was -0.93±0.85 where as cylindrical error of hypermetropic type was found in 04 cases whose mean and standard deviation was 0.34±1.45. Subjective method showed cylinderical error of myopic type in 24 patients

whose mean and standard deviation was -0.92±0.85 where as cylindrical error of hypermetropic type was found in 03 cases whose mean and standard deviation was 0.58±1.66 (table 3 and graph 2).

DISCUSSION

Refractometry in individuals younger than 40 years is usually hampered by the accommodation of the lens. Depending on the age of the patient, accommodation corrects partially or fully for existing hyperopia and examination associated accommodation can additionally make the results of refractometry shift into a more myopic direction. Due to the age-dependence of the accommodative range of the lens, the influence of accommodation on refractometric results increases with younger age and it is therefore of particular concern in pediatric ophthalmology. It includes population-based studies on children.[7]

In the present study hundred patients were examined with the autorefractometer, retinoscopy and subjective refraction under cycloplegicand non- cycloplegic conditions. Dandona R et al[8] assessed the prevalence, distribution, and demographic associations of refractive error in an urban population in southern India and reported that the obtained data, if extrapolated to the 255 million urban population of India, among those >15 years of age an estimated 30 million people would have myopia, 15.2 million hyperopia, and 4.1 million astigmatism not concurrent with myopia or hyperopia; in addition, based on refraction under cycloplegia, 4.4 million children would have myopia and 2.5 million astigmatism not concurrent with myopia or hyperopia.

In the present study, out of 100 patients autorefractometer showed myopia in 39 patients, hypermetropia in 61 and astigmatism in 89 patients under noncycloplegic conditions where as under cycloplegic conditions autorefractometer showed myopia in 38 patients, hypermetropia in 61 and astigmatism in 90 patients.Retinoscopy showed myopia in 34 patients, hypermetropia in 59 and astigmatism in 22 patients under noncycloplegic conditions whereas under cycloplegic conditions retinoscopy showed myopia in 33 patients, hypermetropia in 59 and astigmatism in 27 patients.

Subjective method showed myopia in 34 patients, hypermetropia in 60 and astigmatism in 18 patients under noncycloplegic conditions where as under cycloplegic conditions subjective method showed myopia in 32 patients, hypermetropia in 59 and astigmatism in 27 patients. Thus,autorefractometer showed astigmatism in larger proportion of patients as compared to retinoscopy and on confirming it with subjective method retinoscopy results are correlating with subjective method. Autorefractometer shows increased number of astigmatic error in greater number of patients as compared to retinoscopy and subjective method.

Anton A et al[9] conducted a study on Epidemiology of Refractive Errors among 417 subjects who met the inclusion criteria of a phakic right eye and VA over 6/12. The prevalence of spherical errors was assessed after calculating the spherical equivalent and defining myopia as -0.5 diopters (D) or less and hyperopia as +0.50 D or more. The prevalence of astigmatism over 0.50 D was evaluated in minus cylinder form. They found that estimated prevalences of myopia, hyperopia, and astigmatism, in the population were 25.4% (21.5-29.8%) 43.6% (39-48.4%), and 53.5% (48.7-58.2%), respectively. No significant gender difference was found in the prevalence of any refractive errors. The prevalence of myopia or the mean value did not change significantly with age. The mean hyperopia and the mean astigmatism and the prevalence increased with increasing age. Anisometropia of 1 D or more was present in 12.3% (49/396 subjects). More than 60% of the population in this study was over 40 years of age has a refractive error, with 25.4% myopic and 43.6% hyperopic. Astigmatism is present in over half of the population and the types change with age.

The present study found that in hypermetropic patients mean and standard deviations of spherical error and spherical equivalence were different when calculated before using cycloplegic as compared to after using cycloplegic.Where as cycloplegia had no significant effect on values of cylindrical error and they were same with all the three methods both before and after using cycloplegic. 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 both before and after using cycloplegic.So from above findings it is observed that in hypermetropic children difference in refractive errors values was noted when cycloplegics were used or not used.As under cycloplegiccondition accommodation gets relaxed and thus values of actual refractive error comes, which were initially altered because child was using excessive accommodation in the absence of cycloplegic

Hu YY et al[7] found that non-cycloplegicrefractometry appears to be too unreliable to be considered a useful method to assess the refractive error in children. It agrees also with clinical experience that in young children cycloplegia is usually a must if refractometry is performed. Zhao J et al,[10] Hopkins S et al,[11]Fotedar R et al[12] also reported similar findings.

Hashemi H et al[13] reported that the cycloplegic refraction is more sensitive than the subjective one to measure refractive error at all age groups especially in children and young adults. The cyclorefraction technique is highly recommended to exactly measure the refractive error in momentous conditions such as refractive surgery, epidemiological researches and amblyopia therapy, especially in hypermetropic eyes and paediatric cases.

Accommodation, especially in children, affects the spherical equivalent values, which plays significant role in measurements refraction errors. Therefore, inchildren and patients with high spherical power need to be re-

evaluated by cycloplegicretinoscopy. Cycloplegic refraction remains the gold standard for detecting refractive errors.[5] It goes without saying that the age-old skill of retinoscopy is a vital aid in calculating the accurate refractive error in children.[3]

CONCLUSION

Assessment of refractive error in the pediatric population can be challenging and cycloplegic refractometry was found to be more reliable method for assessing the refractive error in children.

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