ORIGINAL ARTICLE

Mean Visual Acuity Measured by Auto-refraction and Subjective Refraction

Shakeel Ahmad[1], Rashida Riaz[2], Muhammad Haseeb[3], Hafiza Ammara Rasheed[4], Samia Iqbal[5]
[1]Services Institute of Medical Sciences, [2,4]COAS, Mayo Hospital, Lahore. [3]HBS Medical and Dental College, Islamabad. [5]The University of Lahore

ABSTRACT

Purpose: To calculate the mean difference of visual acuity as measured by auto refraction and subjective refraction.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Department of Ophthalmology, Services hospital Lahore from November 2013 to April 2014.

Material and Methods: Using non-probability consecutive sampling 300 eyes of 300 patients fulfilling inclusion criteria were recruited through OPD registration slip. Demographic data including age and gender was recorded. Complete ophthalmic examination was performed. This included measurement of refractive error by auto-refraction as well as subjective refraction. Detailed anterior segment examination with slit lamp and dilated fundus examination with indirect ophthalmoscopy was performed. The collected data was analyzed by using software SPSS version 17.

Results: The mean age of patients was 34.71 ± 7.45 years. There were 156 (52%) males and 144 (48%) females. There were 263 (87.69%) patients who had visual acuity of 6/6 and 37 (12.33%) had 6/9. Mean spherical auto-refraction and subjective refraction was 0.0290 ± 2.58 and -0.2842 ± 2.37 D with mean difference of -0.3133 ± 1.27 D. The mean cylindrical auto and subjective refraction in this study was -.9742 ± 0.78 D and -0.7500 ± 0.81 D and mean difference was 0.2242 ± 0.74 D. The mean cylindrical axis of auto and subjective refraction was 114.88 ± 49.75 and 115.60 ± 49.70 with mean difference as 0.72 ± 3.02 D (p-value < 0.05).

Conclusion: Difference of spherical, cylindrical and cylindrical axis in auto and subjective refraction was significantly different.

Key Words: Refraction, Subjective refraction, Auto-refractometer, Retinoscopy.

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INTRODUCTION

Refraction is a significant component of visual acuity. Clinically, Refraction is used to write spectacle prescription. Subjective refraction is the gold standard for assessing refractive errors[1]. Trial frame refraction is ideal as it allows for a more likely view position. Moreover, the phoropter presents lens changes in 0.25-diopter (D) increment, while trial frame refraction allows the examiner to determine the difference of magnitude between the lens choices accessible so that the variations are distinct by the patient. Autorefractor is frequently used along with subjective refraction in ophthalmological practice for spectacle prescription. The category of autorefractors depend on clinical practice for their ease of use, excellent outcome and

Correspondence to: Rashida Riaz
Research Officer, COAS, Mayo Hospital, Lahore
Email:rashidariaz@hotmail.com

increase response between practitioners and patients[2]. Two studies linked subjective refraction to the auto-refraction in clinical trials for the therapy of diabetic retinopathy[3,4]. These two trials assessed spherical equivalent difference between the two refractive techniques. Autorefraction cannot be replaced by subjective refinement, particularly in children 10 years of age or younger[5,6]. In series of lenses, Autorefractors worked to determine which lens is the clearest for the patient by determining which lens provides the maximum contrast to the retina[7]. Although, this eliminates patient subjectivity, it is less than perfect. Less than 70 percent of patients get a prescription for spectacles from the autorefractor. It can be used as a static retinoscopy, but the consistency and validity of the procedure is smaller as compared to subjective refraction[7]. There are small amount of instruments which appear to control the accommodation effectively in children. Non-cycloplegic auto-refractions are mostly incorrect for measuring hyperopia[8,9]. However, they are perfect, compared to subjective refraction in cycloplegic conditions[10]. Auto-refraction instruments have inner objectives. They are insufficiently used in young patients. However, autorefractors are helpful as a starting point for subjective refraction. Similar to retinoscopy, autorefractors give a starting point, but patients will never be satisfied with auto-refraction alone[11,12]. Further issue with autorefractors is that they only measure to the inner membrane of the retina, rather than to Bruch's membrane, where the photoreceptors are placed. This gives inaccurate readings. Fine-tuning must be performed in front of the patient to obtain the best outcomes.

Auto-refraction without subjective refinement is progressively being used by opticians in Pakistan to prescribe lenses. This research evaluates the mean difference of the visual acuity as measured by auto-refraction and subjective refraction between the vision tests of adults who presented in outpatient department.

MATERIAL AND METHODS

Using non-probability consecutive sampling 300 eyes fulfilling inclusion criteria were included through OPD registration slip. Informed consent was taken. Socio demographic information like age and gender was recorded. Complete ophthalmic examination was performed. This included measurement of refractive error by auto-refraction as well as subjective refraction. Detailed anterior segment examination with slit lamp and dilated fundus examination with indirect ophthalmoscopy was performed. Difference was calculated as per operational definition. All data was entered on pre-designed Proforma. The collected data was analyzed by using software SPSS version 17.

RESULTS

The mean age of patients was 34.71 ± 7.45 years with minimum and maximum age as 16 and 45 years. For details of subjective and auto-refraction refer to tables 1, 2 and 3. The mean cylindrical auto and subjective refraction in this study was -0.9742 ± 0.78 D and -0.7500 ± 0.81 D respectively and mean difference was 0.2242 ± 0.74 D. There was significant difference between mean cylindrical auto and subjective refraction, p-value < 0.001.

Table 1: *Comparison of auto and subjective refraction (spherical).*

	Refraction (Spherical)		
	Auto	**Subjective**	**Difference**
Mean	.0292	-.2842	-.3133
S.D	2.58	2.37	1.27
Minimum	-7.75	-7.50	-9.00
Maximum	5.50	4.50	.75

Paired sample t-test = 4.26 p-value < 0.001

Table 2: *Comparison of auto and subjective refraction (Cylindrical).*

	Refraction (Cylindrical)		
	Auto	**Subjective**	**Difference**
Mean	-.9742	-.7500	.2242
S.D	.78	.81	.74
Minimum	-3.50	-3.00	-1.50
Maximum	.25	2.25	4.50

Paired sample t-test = -5.23 p-value < 0.001

Table 3: *Comparison of Auto and Subjective Refraction (Cylindrical Axis).*

	Refraction (Cylindrical axis)		
	Auto	**Subjective**	**Difference**
Mean	114.88	115.60	.72
S.D	49.75	49.70	3.02
Minimum	25	20	-5
Maximum	180	180	5

Paired sample t-test = -4.11 p-value < 0.001

Table 4: *Comparison of Auto and Subjective Refraction When Stratified for Age Groups.*

Age		Mean	S.D	p-value
16-30 Years	Auto-refraction (Spherical)	0.79	1.82	0.001
	Subjective Refraction (Spherical)	0.37	1.65	
31-45 Years	Auto-refraction (Spherical)	-0.30	2.80	0.004
	Subjective Refraction (Spherical)	-0.57	2.57	
16-30 Years	Auto-refraction (Cylindrical)	-0.83	0.66	0.042
	Auto-refraction (Cylindrical)	-1.04	0.83	
31-45 Years	Subjective Refraction (Cylindrical)	-0.79	0.82	< 0.001
	Subjective Refraction (Cylindrical)	-0.65	0.81	
16-30 Years	Auto-refraction (Cylindrical axis)	108.13	45.63	0.593
	Subjective Refraction (Cylindrical axis)	108.30	45.65	
31-45 Years	Auto-refraction (Cylindrical axis)	117.82	51.27	0.001
	Subjective Refraction (Cylindrical axis)	118.78	51.15	

On stratifying data for age, gender and visual acuity we found significant difference in all refraction (spherical, cylindrical and cylindrical axis). P-value was < 0.05 in Cylindrical axis auto and subjective refraction in 16-30 years of age. For details see Tables 4, 5 and 6.

Table 5: *Comparison of Auto and Subjective Refraction When Stratified for Gender.*

Gender		Mean	S.D	p-value
Male	Auto-refraction (Spherical)	0.70	2.25	0.001
	Subjective Refraction (Spherical)	0.32	2.08	
Female	Auto-refraction (Spherical)	-0.70	2.74	0.006
	Subjective Refraction (Spherical)	-0.93	2.50	
Male	Auto-refraction (Cylindrical)	-0.92	0.62	< 0.001
	Subjective Refraction (Cylindrical)	-0.70	0.64	
Female	Auto-refraction (Cylindrical)	-1.03	0.94	< 0.001
	Subjective Refraction (Cylindrical)	-0.81	0.97	
Male	Auto-refraction (Cylindrical axis)	121.60	48.99	0.002
	Subjective Refraction (Cylindrical axis)	122.31	48.85	
Female	Auto-refraction (Cylindrical axis)	107.60	49.71	0.007
	Subjective Refraction (Cylindrical axis)	108.33	49.77	

Table 6: *Comparison of Auto and Subjective Refraction When Stratified for Visual Acuity.*

Visual Acuity		Mean	S.D	p-value
6/6	Auto-refraction (Spherical)	0.34	2.24	< 0.0001
	Subjective Refraction (Spherical)	0.10	2.05	
6/9	Auto-refraction (Spherical)	-2.16	3.68	0.075
	Subjective Refraction (Spherical)	-3.03	2.66	
6/6	Auto-refraction (Cylindrical)	-0.98	0.80	< 0.001
	Subjective Refraction (Cylindrical)	-0.75	0.84	
6/9	Auto-refraction (Cylindrical)	-0.90	0.69	< 0.001
	Subjective Refraction (Cylindrical)	-0.77	0.63	
6/6	Auto-refraction (Cylindrical axis)	114.37	50.17	0.005
	Subjective Refraction (Cylindrical axis)	114.90	50.20	
6/9	Auto-refraction (Cylindrical axis)	118.51	47.17	< 0.001
	Subjective Refraction (Cylindrical axis)	120.54	46.36	

DISCUSSION

Refractive correction is given in order to correct refractive errors[13]. Clinically, Refraction is used to begin the spectacle prescription so that the best possible acuity can be achieved[14,15]. Ever since, several patients with low vision report that their glasses do not help and some may find it appropriate to neglect refraction. Refraction is the most significant component for patients who use a phoropter to maximize efficacy; however, the refraction of trial frame is favorable for low vision patients because it allows additional position that is extraordinary when required[16]. Furthermore, the phoropter presents lens change in 0.25 diopter (D) increments, although the assessment of refraction allows the examiner to establish the magnitude of difference among the lens choices. Trial frame refraction of low vision patients is time consuming.

Different methods are used to find best corrected visual acuity with refraction. Predominately subjective refraction is used with assessment of lenses or a phoropter, or objective refraction with streak retinoscopy and auto-refraction[17]. The two refractive techniques involve distinct levels of examiner instruction, practice, and time to conduct each method. Subjective refraction needs a fundamental knowledge of optics. Typically, it takes months of practical skills for the clinician to complete subjective refraction appropriately and reproducibly. To master subjective refraction, the technique must be practiced on a large number of patients. In comparison, auto-refraction does not need knowledge about basic ophthalmic optics or practical knowledge in refraction[18]. It only requires fundamental knowledge of how the autorefractor works. It can be acquired from the manual that comes with the autorefractor and it does not require extensive practice on the patients[19]. Over the last few centuries, auto-refraction has become a significant component of routine eye care and clinical practice. It has been shown to be a good tool for screening refractive error in pediatric patients.

An objective refraction in a patient with decreased vision due to refractive error, generally takes about few minutes per eye, while subjective refraction in the same patient with a phoropter or trial frames usually takes time about 10 to 15 minutes. In practice, refraction in a patient with decreased vision and incapability to focus centrally caused by macular disease, requires more time with both auto-refraction and subjective refraction. The difference in time to conduct both refractive methods, whether in patients with good or poor vision, becomes essential part when large numbers of patients are screened. A study was done to compare the refractive correction attained by auto-refraction and subjective refraction at a tertiary care hospital in Pakistan and to establish the association of this difference with age[20]. Two hundred and sixty-nine patients visiting the eye clinic of a large tertiary care hospital in Karachi, Pakistan were studied. Auto-refraction using a Canon R-10 at the same visit, autorefractor and subjective refraction were performed. A clinically major difference among auto-refraction and subjective refraction was defined as a difference of > 0.50 D in sphere, cylinder, spherical equivalent or weighted axis > 10 in axis. The report showed that in 266 right eyes, the medium variation among auto-refraction and subjective refraction in spherical corrections was +0.01D ($p = 0.85$), -0.33D in cylindrical corrections ($p < 0.01$), 10° in axis ($p < 0.01$), and –0.16 D in spherical equivalent ($p = 0.02$). Children 10 years of age or older were 2.23 times more probable to have a clinically significant difference in spherical corrections (OR: 2.23, 95% CI: 1.12-4.47). For left eye, comparable results were observed. Hence, it is concluded that there is a significant difference among the corrections obtained by auto-refraction without help of subjective refraction, typically in children. Auto-refraction without subjective refinement cannot replace subjective refraction. In this research, the mean of all parameters was considerably distinct, p-value < 0.05.

Attebo et al. reported in their research that after adjustment for age, women were slightly more hyperopic (mean +0.75 diopters) than men (mean +0.59 D). The gender adjusted mean spherical error increased with age +0.03 D in persons aged < 60 years to +1.2 D in persons aged ≥80 years ($P < 0.0001$). The gender adjusted mean cylinder power also increased with age, from −0.6 D in persons aged < 60 years to −1.2 D in persons aged ≥ 80 years[21]. These data are similar to our result.

CONCLUSION

The difference of spherical, cylindrical and cylindrical axis in auto and subjective refraction was statistically significant. Due to the large difference, patients must undergo subjective refraction for best corrected visual acuity.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board.

Conflict of Interest

Authors declared no conflict of interest

Authors' Designation and Contribution

Shakeel Ahmad; Vitreo-retina Fellow: *Study design, data collection, analysis, manuscript writing, final review.*

Rashida Riaz; Research Officer: *Study design, data collection, analysis, manuscript writing, final review.*

Muhammad Haseeb; 3rd Year, MBBS student: *Data collection, final review.*

Hafiza Ammara Rasheed; Statistician: *Data analysis, final review.*

Samia Iqbal; Doctor of Optometrist: *Data collection, final review.*

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