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Original Research Article

Study on visual function comparison between ametropes and emmetropes after visual correction

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ABSTRACT

Background: Studies had also shown that 86% of children with refractive error living in rural area are without correction as many are unaware of their problem. Refractive error by itself plays a significant role on one's quality of life and literature had also proven it.
Aim: To study the visual functions in ametropes with 6/6 BCVA and compare it with emmetropes.
Materials and Methods: A cross-sectional study was conducted for a period of one year. All the 200 subjects were tested for refractive error using auto refractor, distance and near visual acuity was assessed with the ETDRS chart, contrast sensitivity was assessed using LEA symbol chart, color vision was assessed using FM 15 online test and field vision was tested using Bjerrum tangent screen, stereopsis was examined using TNO cards, morphometric measurements was done by measuring the axial length using A scan and the K reading was obtained using auto keratometer and finally the functional assessment was analysed using the reading and writing speed.
Results: A total of 200 subjects with 100 ametropes and 100 emmetropes were included in our study. Colour vision, near point accommodation, near point convergence, axial length were significantly altered in ametropes. Contrast sensitivity, steropsis and reading speed were significantly reduced in ametropes compared to emmetropes. There was no significant difference in visual functions between different types refractive error subjects like myopia, hypermetropia and astigmatism.
Conclusion: The present study proves that visual acuity alone is not an indicator for assessing the quality of vision instead the complete visual functions has to be screened on all patients reporting with refractive error.

1. Introduction

Uncorrected refractive error is the most common cause for visual impairment and blindness worldwide as well as in India and if presbyopia is included the magnitude of refractive error crosses more than 80% much.[1–4] In India the prevalence of myopia and hyperopia among school going children was found to be between 10 and 35%(reference needed).[5] Studies had also shown that 86% of children living in rural area are with refractive error and without correction as many are unaware of their problem and they are in need for spectacles.(ref needed) Children adjust to poor vision by following certain strategies such as changing position in the classroom, bringing the objects more closer and avoiding certain tasks which requires more visual concentration.[5] As per our National Program for Prevention and Control of Blindness it is recommended to screen children for early detection and intervention for refractive error.[5]

The number of years of life that the refractive error affects is more than any other common eye diseases such as cataract and glaucoma, which usually occurs only at the old age. Refractive error by itself plays a significant role on one's quality of life (QoL) and literature also demonstrates

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the fact.[6,7]

Although many quantitative studies were conducted to assess the prevalence of refractive error, there are very few studies on the visual function assessment among those with refractive error.[8] Ideally, patient consultation through in-depth interviews or focus group discussions are one of the most important stages of developing the content of a high quality patient-reported outcome (PRO) instrument.[9] Surprisingly, these preceding qualitative studies have not been discussed or published in detail.. Researchers emphasize that health-related QoL assessment provides valuable information about the different aspects of health of the child which would help in optimizing the therapeutic strategies.[10,11]

The quality of life for refractive error patients is measured by assessing their visual functions and as of today not much studies had been conducted in this area and so the present study aimed at assessing the visual functions among ametropes after refractive error correction and comparing it with emmetropes.

2. Materials and Methods

A comparative observational study was conducted for a period of one year between June 2017 and May 2018 in the ophthalmology department of our medical college hospital. The study was approved from the institutional ethical committee and the informed consent was obtained from all the study participants. A total of 200 study subjects in the age group between 10 and 25 years were recruited for the study in which 100 were emmetropes with uncorrected visual acquity of 6/6 and the remaining 100 were ametropes with best corrected visual acquity of 6/6 in each eye. The inclusion criteria for all ametropes were myopia with >/= 1D, hyperopia >/= 1.50 D and astigmatism with >/=1 D Cyl. Ametropes with any anterior or posterior segment abnormalities, with strabismus and uncooperative patients were excluded from the study.

Refractive error measurement and refraction for best distance and near correction were carried out by an optometrist using subjective refraction with trial lenses and frames, a portable auto refractor, and/or retinoscopy, with most enrollees receiving a combination of approaches. Before randomization to either of the 2 arms of the study, a research staff member assessed distance and near visual acuity while the resident used habitual correction (or nothing if they had no correction) for each eye separately and together. Testing was carried out in either the resident's room or another private area with adequate lighting. Distance and near visual acuity was assessed with the ETDRS chart using its standard protocol and expressed as the logarithm of the minimum angle of resolution (logMAR). 21, contrast sensitivity was assessed using LEA symbol chart, colour vision was assessed using FM 15 online test and field vision was tested using Bjerrum tangent screen.

Orthoptic functional assessment was done by using RAF near point rule for near point of accommodation (NPA) and near point of convergence (NPC) and the stereopsis was examined using TNO cards. Morphometric measurements was done by measuring the axial length using A scan and the K reading was obtained using auto keratometer and finally the functional assessment was analysed using the reading and writing speed.

All data were entered and analysed using SPSS version 21. Mean and standard deviation was derived for all the parametric variables and percentage was calculated for the frequencies. Chi-square test and Kruskal wallis test was used to assess the statistical inference between the two groups.

3. Results

The age and gender wise distribution among the emmetropes and ametropes shows that the mean age among both the groups was almost similar (17 years) and the male and female ratio was 0.87: 1.0 in both the groups and no significant difference was observed with respect to age and gender between emmetropes and ametropes (Table 1). The contrast acuity at 1.25% showed that at 3 meter distance 99 emmetropes had better contrast acquity and 24 ametropes with best corrected visual acuity had better contrast acuity. At 2 meter distance, the remaining one emmetrope also had the better contrast acuity 48 ametropes (with BCVA) had better contrast acuity. At 1 meter distance the remaining 28 ametropes with BCVA had better contrast acuity (Table 2). The colour vision assessment was done by measuring the confusion angle and it had shown that the confusion angle was high among ametropes with BCVA compared to emmetropes in both eyes and the difference in the confusion angle was found to be statistically significant (Table 3). The steropsis measurement was better than 60 arc sec among 99 emmetropes whereas among 71 ametropes it was worse than 60 arc sec and similarly for orthoptic measurements for near point accommodation and near point convergence among emmetropes it was 9.75D and 9.79D and in ametropes it was 9.03D and 8.96D respectively and the difference was found to be statistically significant. The axial length was found to be statistically significantly higher among ametropes than emmetropes in both the eyes. Reading speed showed significantly higher among emmetropes than ametropes whereas the writing speed remains almost same between emmetropes and ametrope (Table 4). The various types of refractive errors reported in our study subjects showed that majority (50%) had astigmatism, which is followed by myopia (47%) and only 3% of the ametropes were hypermetropic. The visual functions were compared between the three types of refractive error and it was found that except for the axial length, which was

Table 1: Age and gender wise distribution of the study subjects

Age group	Emmetropes		Ametropes		P value
	Male	Female	Male	Female	
10 – 14	13 (28.2%)	16 (29.6%)	17 (36.1%)	21 (39.6%)	0.724
15 – 19	25 (54.3%)	32 (59.2%)	22 (46.8%)	27 (50.9%)	0.813
20 – 25	8 (17.3%)	6 (11.1%)	8 (17%)	5 (9.4%)	0.885
Total	46 (100%)	54 (100%)	47 (100%)	53 (100%)	0.697
Mean ± SD	17.6 ± 6.4	17.2 ± 7.4	16.9 ± 6.6	17.6 ± 5.8	

Table 2: Contrast acquity at 1.25% among the study subjects

Contrast acquity	Emmetropes	Ametropes	P value
At 1 meter distance	0	28	<.001
At 2 meter distance	1	48	
At 3 meter distance	99	24	
Total	100	100	

Table 3: Colour vision among the study subjects

Colour vision	Left eye		Right eye	
	Emmetropes	Ametropes	Emmetropes	Ametropes
Confusion angle	81.6^0	119.4^0	87^0	114^0
P value	<.0001		<.0001	

Table 4: Steropsis, orthoptic measurements, axial length, reading and writing speed among the study subjects

Parameter		Emmetropes	Ametropes	P value
Stereopsis	Better than 60 arc sec	99	29	<.0001
	Worse than 60 arc sec	1	71	<.0001
Orthoptic measurement	Near point accommodation	9.75 D	9.03 D	<.001
	Near point of convergence	9.79 D	8.96 D	<.001
Axial length	RE	22.91 mm	23.97 mm	<.001
	LE	22.88 mm	23.97 mm	<.001
Reading speed (words/min)		79.5	73.4	<.001
Writing speed (words/min)		26.02	26.09	0.991

Table 5: Comparison of visual function assessment among the various refractive error patients

Parameters	Myopia	Hyper	Astig	Significance(kruskal wallis)
Contrast sensitivity	0.21	0.215	0.195	P >0.05
Colour vision (degrees)	65.10	66.26	63.37	P >0.05
Stereopsis (arc sec)	137.14	120	148.51	P>0.05
Near point accommodation (diopters)	8.9	8.5	9.165	P >0.05
Near point convergence (diopters)	8.86	8.33	9.12	P >0.05
Axial length ((in mm)	24.09	22.08	23.98	p = 0.006
Keratometry difference (in mm)	0.62	0.72	1.5	p = 0.000
Reading Speed (words/min)	74.67	72.00	72.32	P>0.05
Writing Speed (words/min)	27.51	22.33	24.68	P>0.05

maximum in myopes and keratometry difference, which was highest in astigmatism subjects, all the other visual function parameters did not show a statistical significant difference between the three groups (Table 5).

4. Discussion

Most of the studies conducted so far on refractive errors were mainly measuring the prevalence and the factors influencing it not much studies done on visual function assessment among refractive error patients. So the present study focused on assessing the visual function between ametropes after correction and emmetropes. The study was conducted with 100 emmetropes and 100 ametropes and the mean age among both the groups was 17 years and this was in par with the previous studies done by Dandora et al. and Wensor et al.[12,13]

In the current study the colour vision assessment was done by measuring the confusion angle and it was shown that the confusion angle was high among ametropes than the emetropes, studies done by Bradley et al., Noorden et al. and McCulley et al. also found a statistically significant correlation between colour vision defect) and the visual acquity with BCVA 6/6.[14–16] In the present study the contrast sensitivity at 1.25% measured at 3 meters distance showed a significant difference between ametropes with BCVA 6/6 and emmetropes and the studies done by Moseley M. J. et al., Haegerstrom-Portnoy G et al. and Cao D et al. had also proven lesser contrast sensitivity among ametropes.[17–19]

The near point accommodation and the near point convergence among emmetropes showed a significant difference in comparison with ametropes in the present study and the lack of association between an altered visual function examination and asthenopia reinforces the findings of the majority of studies.[20,21] This aspect may be related in part to children not finishing activities that induce eye discomfort symptoms, that is, children who due to an undiagnosed visual function alteration feel discomfort when doing near activities requiring binocular, stereoscopic, and clear focus vision, naturally avoid reading, and, as a consequence, complain less about asthenopia.[22] Moreover, many children do not report having asthenopia symptoms to their parents and teachers, principally because they are not aware of what it feels like to read comfortably.

In our study we found that the stereopsis was worse than 60 arc sec in most of the ametropes (70%) and it is in par with the studies done by Faghihi M et al. in Iran in 2011 and Robaei D et al. in London 2008 which showed that patients with long standing refractive errors had poor stereopsis.[23,24] The mean axial length was found to be high among the ametropes than the emmetropes which might be due to the more number of myopic patients among the ametropes and among the ametropes we found the axial length was significantly higher in myopes than that of hypermetropes and asitgmatism patients. Similar findings were noted by Gernet H et al. in 1964 in Sweden and Zadnik K et al. in Europe in 2003, found that there is a general pattern of ocular growth between the ages of 6 to 14 years.[25,26] Lourdes Llorente et al., also found that the Axial Length (AL) of hyperopic eyes (22.62 + 0.76 mm) was significantly lower ($p<.001$) than the axial length of myopic eyes 25.16 + 1.23 mm in 30.3 + 5.2 and 30.5 + 3.8 years old, respectively.[27]

In assessing the reading and writing speed we found a statistical significant difference only in the reading speed where the emmetropes were able to read in much faster speed than the ametropes but the writing speed did not show any difference between ametropes and emmetropes. All the visual function parameters compared between myopes, hypermetropes and astigmatism patients did not show any significant difference except for the axial length which was high among myopes and the keratometry difference was more among astigmatism patients.

5. Conclusion

The present study proves that visual acuity alone is not an indicator for assessing the quality of vision instead the complete visual functions has to be screened on all patients reporting with refractive error and necessary steps needs to be taken to improve their visual functions which in need would probably have an impact on their quality of life.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

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