ASSOCIATION BETWEEN VISUAL PERFORMANCE AND ABERRATION USING QUALITY OF LIFE IMPACT OF REFRACTIVE CORRECTION (QIRC) QUESTIONNAIRE IN MODERATE AND HIGH MYOPIC PATIENT

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ABSTRACT

Introduction: This study aimed to evaluate the association between visual performance and aberration using quality of life impact of refractive correction (QIRC) questionnaire in moderate and high myopic groups.

Methods: 120 eyes of 60 participants were recruited and both right and left eyes of the myopic subjects were measured separately. For satisfaction in visual performance, Quality of Life Impact of Refractive Correction (QIRC) questionnaire were given to all participants. For aberration measurement, WASCA wavefront analyser were done in dimmed illuminated room. Aberration was recorded as root mean square (RMS). WASCA built-in wavefront analysis computed three best measurements of RMS for third and fourth orders of aberration. The average of three measurements were taken for analysis. All data were expressed in mean and standard deviation. Statistical analyses were performed using Predictive analytics software. $P < 0.05$ was set as the level of significance. Independent T-test were done to compare all parameters between moderate and high myopia, including QIRC scores.

Results: This study found the mean QIRC scores were approximately similar between moderate and high myopia (Both $P > 0.05$). However, high order aberration (HOA) comprise of third and fourth order aberration were found significantly higher in high myopia group compared to moderate myopia group (Both $P < 0.05$).

Conclusion: This study found that QIRC questionnaire could not be able to differentiate subjective visual performance between moderate and high myopia.

KEYWORDS: aberration, refractive error, myopia, QIRC, quality of life

INTRODUCTION

Myopia is a common refractive error where distant vision are affected than near. Several studies reported the prevalence of myopia is increasing especially in the East Asian population (Morgan et al., 2012; Rudnicka et al., 2016). Recent study revealed rapid myopic transition in the East and South Asians population are evident due to rapid economic transition with near vision activities along with less outdoor activities are the contributor causes of myopia (Rudnicka et al., 2016). In general, myopia can be distinguished into axial myopia and refractive myopia as axial myopia occurs due to the increase of eye axial length while having a normal refractive power. Contrarily, refractive myopia occurs due to the increase of refractive power while having a normal axial length of the eye (Czepita, 2014). Study by Hashemi et al. (2017) showed that the prevalence of myopia was greatly higher in those with age of 21 to 30 years and over-70 years compared to the 16 to 20 years age groups and increasing especially in higher education. Association between myopia and quality of life (QoL) has been widely reported (Pesudovs et al., 2006; Lamoureux et al., 2008; Karimian et al., 2010; Kandel et al., 2017) with increasing of myopia does leads to greater challenging QoL.

Aberration can be define as imperfections of the visual system due to light being unable to focus effectively onto the retina, which also commonly known as wavefront aberration. Thus, image clarity relies on the accuracy of the eye's optical system and irregularities of the corneal curvature influenced the quality of retinal images. Aberration commonly been measured quantitatively using ray tracing technique such as ATLAS and WASCA and noted as Root mean square (RMS). A 2D topographic image is displayed to represent the wavefront distribution of the corneal surface. Previous study had reported positive correlation between refractive error and aberrations in myopic population (Karimian et al., 2010). However, to the best of our literature research, limited evidences available that discussed association of visual performance and aberrations using the QIRC questionnaire. Thus, this study aimed to evaluate visual performance and aberrations among moderate to and myopic eyes based on Quality of Life Impact of Refractive Correction (QIRC) questionnaire.

MATERIALS AND METHODS

120 eyes of 60 participants were recruited in this prospective cross-sectional study. Both right and left myopic eyes were measured separately. The inclusion criteria of the research are healthy participants with age ranging from 19 to 25 years old for both male and female having spherical refractive error between -3.00D to -5.00D (moderate myopia) or more than -5.00D (high myopia) with maximum cylindrical error of -1.25DC, and maximum pupil size of 6.5 mm. The exclusion criteria are those with abnormal tear film (Che Arif et al., 2020; Che Arif et al., 2021; Mohd Radzi et al., 2022) and corneal opacity (Hilmi et al., 2020; Che Azemin et al., 2016; Hilmi et al., 2019) or irregularity related conditions such as pterygium (Mohd Radzi et al., 2017; Mohd Radzi et al., 2018; Mohd Radzi et al., 2019; Mohd Radzi et al., 2019; Mohd Radzi et al., 2019; Mohd Radzi et al.,

2019; Che Rosli et al., 2020; Mohd Radzi et al., 2020), history of ocular trauma and systemic diseases. Participants who worn soft contact lens within two weeks of the measurements, or four weeks for rigid gas-permeable contact lens were excluded (Cook et al.. 2019; Moshirfar et al., 2019; Xu et al., 2022).

Prior to commencement of study, ethical approval was obtained from IIUM Research Ethics Committee [IIUM/504/14/11/2/IREC 2019-KAHS (U)] and it is comform with the Tenets Declaration of Helsinki. All participation are based on voluntary basis, and consent from each participants was obtained prior to any procedures. All data collection was conducted at IIUM Optometry Clinic, Kuliyyah of Allied Health Sciences, International Islamic University Malaysia (IIUM) Eye Specialist Clinic (IESC), Kuliyyah of Medicine, Kuantan, Pahang, Malaysia. Firstly, each of participant was given the Quality of Life Impact of Refractive Correction (QIRC) questionnaire to be completed. Then, standard optometric examination which includes slit-lamp examination, fundus and visual field was done.

For aberration measurement, WASCA HOAs and wavefront analysis were done using WASCA in a dimmed illuminated room. The aberrometer would sample the pupil through an array of lenslets in which the number of spots depend on the pupil diameter. Built-in wavefront analysis then compute three best measurements which include root mean square (RMS) for third and fourth orders of aberration. The average of three measurements were taken for analysis. All data were expressed in mean and standard deviation. Normality testing was based on ratio of skewness kurtosis with ± 2.50 are considered as normally distributed (Mohd Radzi et al., 2017). Statistical analyses were performed using IBM SPSS (Predictive analytics software) Version 24 (IBM Corp, Armonk, NY, USA). $P < 0.05$ was set as the level of significance.

RESULTS

The mean age of participants was 25.2 ± 64.8 years (N = 120 eyes). Normality testing revealed that all data were normally distributed ($p > 0.05$) with approximately balance number of participants for each group; moderate myopia (N = 61) and high myopia (N = 59). Based on descriptive analysis, both third and fourth order aberration were found significant in high myopia group compared to moderate group (Both P-value < 0.05), as summarised in Table 1.

Table 1: Demographic data on refractive error and root mean square (RMS) values of aberration for third and fourth order for both groups.

Parameter	Moderate	High	P-value
Degree of myopia (D)	-3.86 ± 0.56	-6.23 ± 1.03	
Aberration (Mean ± SD μm)			

Third-order	0.13 ± 0.10	0.28 ± 0.12	P < 0.001
Fourth-order	0.09 ± 0.05	0.14 ± 0.07	P < 0.05

Based on independent T-test analysis, this current study found that there were no significant difference between the mean QIRC scores in both moderate and high myopia group (Both P-value > 0.05). However, it is worth to note that the mean QIRC score for high myopia were relatively lower than moderate myopia group as summarised in Table 2 below.

Table 2: Mean QIRC scores for both moderate and high myopic groups.

QIRC Questionnaire	Moderate myopia	High myopia	P-value
	Mean ± SD	Mean ± SD	
Question 1 How much difficulty do you have driving in glare conditions?	58.30 ± 5.84	51.24 ± 13.82	0.124
Question 2 During the past month, how often have you experienced your eyes feeling tired or strained?	56.53 ± 11.22	63.57 ± 4.89	0.113
Question 3 How much trouble is not being able to use off-the-shelf (non prescription) sunglasses?	30.96 ± 8.92	37.40 ± 14.79	0.132
Question 4 How much trouble is having to think about your spectacles or contact lenses or your eyes after refractive surgery before doing things; e.g. travelling, sport, going swimming?	45.92 ± 14.30	38.20 ± 12.93	0.122

Question 5 How much trouble is not being able to see when you wake up; e.g. to go to the bathroom, look after a baby, see alarm clock?	49.67 ± 11.50	34.60 ± 13.03	0.094
Question 6 How much trouble is not being able to see when you are on the beach or swimming in the sea or pool, because you do these activities without spectacles or contact lenses?	39.90 ± 11.22	36.12 ± 6.51	0.112
Question 7 How much trouble are your spectacles or contact lenses when you wear them when using a gym / doing keep-fit classes / circuit training etc?	48.30 ± 8.14	39.72 ± 13.82	0.093
Question 8 How concerned are you about the initial and ongoing cost to buy your refractive surgery/ current spectacles and/or contact lenses/?	44.95 ± 13.98	41.44 ± 11.68	0.344
Question 9 How concerned are you about the cost of unscheduled maintenance of your refractive surgery/ spectacles/ contact lenses; e.g. breakage, loss, new eye problems?	37.45 ± 13.13	35.52 ± 8.00	0.233
Question 10 How concerned are you about having to increasingly rely on your spectacles or contact lenses since you started to wear them?	37.37 ± 6.25	34.56 ± 9.42	0.213
Question 11 How concerned are you about your vision being not as good as it could be?	34.24 ± 14.84	38.88 ± 10.43	0.144

Question 12 How concerned are you about medical complications from your choice of optical correction (refractive surgery, spectacles and/or contact lenses)?	32.80 ± 9.99	33.74 ± 10.92	0.432
Question 13 How concerned are you about eye protection from ultraviolet (UV) radiation?	42.74 ± 8.07	47.74 ± 12.88	0.221
Question 14 During the past month, how much of the time have you felt that you have looked your best?	34.35 ± 11.16	33.23 ± 11.10	0.412
Question 15 During the past month, how much of the time have you felt that you think others see you the way you would like them to (e.g. intelligent, sophisticated, successful, cool, etc)?	37.25 ± 11.63	34.97 ± 10.29	0.153
Question 16 During the past month, how much of the time have you felt complimented / flattered?	40.90 ± 10.85	37.28 ± 12.41	0.145
Question 17 During the past month, how much of the time have you felt confident?	28.54 ± 6.99	31.91 ± 13.72	0.197
Question 18 During the past month, how much of the time have you felt happy?	30.01 ± 11.43	32.10 ± 15.72	0.313
Question 19 During the past month, how much of the time have you felt able to do the things you want to do?	24.83 ± 15.08	19.37 ± 11.10	0.184
Question 20 During the past month, how much of the time have you felt eager to try new things?	33.00 ± 13.46	28.93 ± 11.10	0.134

DISCUSSION

This study aimed to evaluate relationship between higher-order aberrations (HOA) and QIRC scores as function for subjective visual performance. This study revealed HOA was found higher in high myopia compared to moderate myopia. This findings in coherent with several previous reports (Li et al., 2017; Neroev et al., 2021). There are conflicting evidences in describing HOA in comparison with types of refractive error. Some reports found higher HOA predominantly found in hyperope compared to myopes (Llorente et al., 2004; Martinez et al., 2009) myopes were higher than hyperopes (Kirwan et al., 2006; He et al., 2002) and no difference between all types of visual impairment (Carkeet et al., 2002).

Increased effect of aberration with increased of myopia could be due to changes in the internal optics of the eye such as anterior chamber depth and lens thickness. Another challenging factor in bridging the gap between HOAs and refractive error is age. A study had reported that HOA in particular spherical aberrations decreased with age [30]. Thus, this study findings could be justified as participants recruited are relatively young compared to other studies that includes cataract or elder groups as their target participants (Jing et al., 2016; Zhang et al., 2018). Another critical factor is pupil size. Pupil size plays an important role in the estimation of HOAs, and this current study was performed using a 6 mm pupil scan diameter, which is widely used to evaluate optical aberrations. Previous work (Wang et al., 2003) had commented that coma-like aberrations less affected with pupil dilation while spherical-like aberration showed significant increase in 5 - 6 mm pupil size, compared to 4 - 5 mm pupil size. Thus, variation in pupil size could misled the HOA findings.

QIRC questionnaire were meant to describe quality of life (QOL) of people with refractive correction by spectacles, contact lenses, and refractive surgery in the pre-presbyopic age group. This current study findings revealed that high myopic patients visual performance satisfaction were lower than the moderate myopic groups, however not statistically and clinically significant as reported by other study (Ang et al., 2015; Chiam and Mehta, 2019). Lower QIRC mean scores in high myopic group indicates lower satisfaction in visual performance compared to moderate myopic group. Moreover, this study found no significant association between QIRC scores and aberration, as reported by previous study (Han et al., 2020). Quality of life metrics in QIRC aimed to evaluate wellbeing of an individuals. It is worth to note that it is possible that some ocular conditions that may not cause reduced visual acuity, but create discomfort such as ocular allergy. Thus, QIRC scores should not be taken without prudent consideration.

The strength of this study includes measurement of ocular aberration which also considering the posterior cornea. This is to ensure the measurement HOA is not overestimate (Jiang et al., 2018). It is also important to highlight some limitations in this study. Three most important limitations were that aberrations were assessed using a 6

mm pupil scan diameter in relatively young participants and the number of patients recruited are generally limited. Secondly, bbnormal tear film condition could also affect measurement of aberration due to uneven ocular surface (Che Arif et al., 2020; Che Arif et al., 2021; Mohd Radzi et al., 2022), thus may affected the results. However, all participates were scrutinised to ensure abnormal tear film problems were excluded.

CONCLUSION

Aberration and QIRC scores are more prominent in high myopia compared to moderate group, however, prudent consideration need to be taken for QIRC questionnaire analysis.

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