ORIGINAL ARTICLE

Distance vision, near vision and quality of life between preferred emmetropia and residual myopia in monofocal intraocular lens implantation - A Comparative study

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ABSTRACT

Introduction: This study was done to evaluate the visual acuity and quality of life in predicted emmetropia (EM) and predicted residual myopia (RM) patients following phacoemulsification with monofocal intraocular lens implantation.

Materials and Methods: This prospective comparative study was conducted in the ophthalmology clinic of the Universiti Sains Malaysia Hospital, Kelantan, Malaysia. Overall, 139 patients with senile cataract were randomised into EM and RM groups. At three months post-operatively, patients were assessed for distance and near vision, as well as quality of life using a modified VF-14 questionnaire.

Results: Thirty-six patients (64.3%) in the EM group and 30 patients (52.6%) in the RM group (p = 0.209) showed good distance vision (LogMAR 0.3 or better). Fifty patients (87.7%) in the RM group and 27 patients (48.2%) in the EM group gained significantly higher satisfactory near vision (p < 0.05). The quality of life in both groups was good, with a mean modified VF-14 score of 94.5 (SD 2.68) for the EM group and 95.1 (SD 3.19) for the RM group (p = 0.286). Female patients scored significantly higher than males for total activities (p = 0.010) and distance vision-related activities (p = 0.001). The RM group had significantly better patient satisfaction for near vision-related activities compared to the EM group (p = 0.001). In particular, the item 'reading small print' was significantly better in the RM group (p = 0.003).

Conclusion: Patients in the predicted RM group gained more satisfactory near vision than patients in the EM group, with significantly better quality of life for near vision activities.

KEYWORDS:
Quality of life, post-cataract operation, residual myopia, near vision

INTRODUCTION

Cataract is the main cause of preventable blindness worldwide, contributing to 51% of the total incidence.[1] In Malaysia, 58.6% of preventable blindness cases are caused by unoperated cataracts.[2] Currently, there is no effective prevention for cataracts, and the only treatment is to remove the cloudy lens.[3]

Intraocular lens (IOL) implantation is the commonest practice of visual rehabilitation after cataract surgery. Monofocal or fixed focal IOLs have only one focus at distance; thus, the placement of a monofocal IOL requires corrective lenses (spectacles) after surgery for near vision-related tasks. Although no statistical difference was found between multifocal (MFIOL) and monofocal IOL with respect to achieving a post-operative best-corrected visual acuity (BCVA) of 6/6, near vision was often found to be better with MFIOL.[4] However, MFIOL is costly and would be a luxury for most people in poor and developing countries. In the Malaysian set up, monofocal IOL is still more popular than multifocal partly because it is more affordable. The final refractive result depends on the accuracy of biometric data and the appropriate use of IOL power calculations.[5] The target for residual refractive result post-operative slightly varies among ophthalmologist. Some ophthalmologists recommend emmetropia, while others routinely prefer residual myopia up to –1.00 dioptres (D).[6] However, there is still lack of evidence on the impact of these target final refractive result post-operative to the quality of life of the patients.

The post-operative outcome of functional vision is classified according to both objective and subjective findings. Objective parameters include uncorrected visual acuity, contrast sensitivity, glare disability, visual field and colour vision. Subjective parameters are best evaluated through interviews or questionnaires since the domains covering daily activities can be tailored to local populations. Several questionnaires are available for this purpose, such as the Visual Function Index 14 (VF-14)[7,8,9], European Quality of Life 5 Dimensions (EQ-5D) questionnaire,[10] the National Eye Institute Refractive Error Quality of Life Instrument-42 (NEI RQL-42),[11] and the Glasgow Benefit Inventory.[12] VF-14 questionnaire is a self-reported outcome-based questionnaire which was initially designed for cataract patients. However it has now been widely used in glaucoma, retina and corneal diseases. It has been modified to include activities that are more relevant to the local population in other languages.[13,14] This

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questionnaire was translated into Bahasa Malaysia and Malaysian activities such as reading fine print such as Quran, sewing, wood carving and carpentry were added. The modified Malaysian VF-14 questionnaire has been used by previous authors.[15] VF-14 was preferred due to the simple format and easily administered thus increasing patient compliance.

This study was aimed to evaluate the visual acuity and quality of life (QOL) in predicted emmetropia (EM) group and predicted residual myopia (RM) group following phacoemulsification with monofocal IOL using a modified VF-14 questionnaire. The VF-14 is used for the assessment of QOL in post-operative cataract patients. A previous study suggested that VF-14 is a dependable and effective measure of QOL.[16] This study compares EM and RM with QOL as a measure of the functional vision post-phacoemulsification with IOL implantation.

MATERIALS AND METHODS

Patients

A total of 139 patients were selected for this study. Patients were recruited from the eye clinic of the Universiti Sains Malaysia Hospital, Kubang Kerian, Kelantan, Malaysia. Ethical approval was obtained from the Ethical Research Committee of the Universiti Sains Malaysia. Written consent was obtained from the participants. All senile cataract patients undergoing phacoemulsification with monofocal IOL were enrolled in the study. The predictive refractive power of intraocular lens selection was done by simple randomization method. The patients were divided into two groups using closed envelope method. They were given an envelope containing a paper written either Group A or Group B. Group A (predicted emmetropia) were patients that using intraocular lens with predicted refractive power of 0.00 to -0.50 D and Group B (predicted residual myopia) were patients that using IOL with predicted refractive power of -0.51 to -1.00D. At 6 weeks post-operatively, distance and near vision were recorded, and questionnaires were given to evaluate patient QOL.

Clinical evaluation

Patients were subjected to full ophthalmic examinations including anterior segment, intraocular pressure measurement and fundus examination, by either ophthalmologists or medical officers. Patient with any ocular pathology were excluded at pre-operative stage. Biometry was performed by two trained ophthalmic technicians using a Sonomed A2500 contact A-scan (Sonomed, Florida, USA). To reduce bias, multiple axial length measurements were taken, and the most reproducible with the lowest standard deviation was taken as the value. Keratometry was performed using an automated keratometer for horizontal and vertical K values. The average K reading was used in the SRK II formula for IOL calculation.

Surgery

Phacoemulsification was performed using a standardised technique. In brief, a 2.75-mm clear corneal incision was made, followed by capsulorhexis, using the 'divide and conquer' technique and a phacoemulsification system (Infiniti, Alcon Surgical Inc., Forth Worth, Texas, USA). Implantation of a monofocal IOL (AcrySof IQ SN60WF, Alcon Laboratories Inc., Forth Worth, Texas, USA) was performed by three ophthalmologists.

Data collection

Post-operative exclusion criteria included any intra operative or post-operative complications, spherical equivalent differing from predictive refractive power more than + 0.50 D and astigmatism more than -2.00D either pre-existing preoperatively or surgically induced postoperatively. At 10–12 weeks post-operatively, patients were interviewed for demographic data, followed by evaluation for distance vision using a LogMAR chart. Patients with a LogMAR of 0.3 or better were grouped as 'satisfactory distance vision', and those with a LogMAR of less than 0.3 were grouped as 'non-satisfactory distance vision'. Subjective refraction using Red green filter, Jackson Cross Cylinder and Binocular Balancing was performed to obtain the BCVA and spherical equivalence. Near vision was checked using a Jaeger chart. Patients who scored J3 or better were grouped as 'satisfactory near vision,' and those who scored less than J3 were grouped as 'non-satisfactory near vision'.[17]

QOL (modified VF-14 questionnaire)

Post-operative QOL evaluates the perception of the effectiveness of their surgery of patients via the use of a health related QOL questionnaire. This study used a modified Bahasa Malaysia version VF-14 questionnaire which assessed the post-operative satisfaction of the patients with their visual function in three domains: near, intermediate and distance. The questionnaire was modified from English to Malaysian, and some activities relevant to the local population were added. A score was given with a scale of 0 to 100. Scores on all activities that the patients could perform or could not perform were then averaged, yielding an average score between 0 and 4. This average score was then multiplied by 25, resulting in a possible final score ranging from 0 (unable to do all applicable activities due to vision problems) to 100 (able to do all applicable items without difficulties). Patients with a VF-14 score between 95.01 and 100.00 were considered 'satisfied', while those who had a VF-14 score of 95.00 or less were considered 'not satisfied'. For individual items, patients who scored 4 were considered 'satisfied', and those who scored less than 4 were considered 'not satisfied'.

Statistical analysis

The data were analysed using the Statistical Package for Social Sciences version 18.0 (SPSS Inc., Chicago, IL, USA). Statistical analyses were performed using Pearson's chi-squared test for sociodemographic data, and descriptive analysis was used for visual acuity and QOL. The differences between the two groups were analysed using Pearson's chi-squared test, independent t-test and one-way ANOVA with post hoc Tukey test. A p value of < 0.05 was considered statistically significant.

RESULTS

Of the 139 patients, 26 patients were excluded because their post-operative refractive power difference was more than +0.50 D compared to the prediction. No patients had surgically induced astigmatism of more than –2.00 D.

Table I: Distribution of sociodemographic data

	EM		RM		*p-value
	n=56	(%)	n=57	(%)	
Sex					
Male	28	(50.0)	34	(59.6)	0.303
Female	28	(50.0)	23	(40.4)	
Race					
Malay	48	(87.5)	48	(82.5)	0.453
Chinese	7	(12.5)	10	(17.5)	
Education					
Less than primary education	14	(25.0)	17	(29.8)	0.794
Primary school	13	(23.2)	13	(22.8)	
Secondary school	15	(26.8)	11	(19.3)	
Higher education	14	(25.0)	16	(28.1)	
Occupation					
Housewife	21	(37.5)	21	36.8)	0.934
Government servant	4	(7.1)	6	(10.5)	
Self-employed	17	(30.4)	17	(29.8)	
Pensioner	14	(25.0)	13	(22.8)	

EM = Predicted emmetropia, RM = Predicted residual myopia
*Pearson's chi-square test, p-value < 0.05

Table II: Distribution of distance and near vision

	EM (n=56)		RM (n=57)		*p-value
	S n (%)	NS n (%)	S n (%)	NS n (%)	
Distance vision					
LogMAR	36 (64.3)	20 (35.7)	30 (52.6)	27 (47.4)	0.209*
Near vision					
Jaeger chart	27 (48.2)	29 (51.8)	50 (87.7)	7 (12.3)	0.001*

EM = Predicted emmetropia, RM = Predicted residual myopia
S = LogMAR 0.0–0.3; J3 or better
NS = LogMAR worse than 0.3; J worse than J3
*Pearson's chi-squared test, p-value < 0.05

Table III: Comparison of actual and predictive refractive power

	EM Mean (SD)	RM Mean (SD)	Mean differences (95% CI)	*p-value
Actual refractive power (D)	–0.39 (0.31)	–0.78 (0.30)	0.39 (0.28, 0.50)	<0.05
Predictive refractive power (D)	–0.37 (0.11)	–0.69 (0.14)	0.31 (0.26, 0.36)	<0.05

EM: Predicted emmetropia; RM: Predicted residual myopia
*Independent t test, p-value < 0.05

Table IV: The mean VF-14 scores in male and female patients

VF-14 score	Male Mean (SD)	Female Mean (SD)	Mean differences (95% CI)	*p-value
Total	94.2 (3.08)	95.6 (2.60)	–1.42 (–2.50, -035)	0.010
Near vision	91.3 (7.67)	92.7 (6.51)	-1.38 (–4.07, 1.30)	0.310
Intermediate vision	99.6 (1.54)	99.0 (2.30)	–3.47 (–0.14, 1.30)	0.115
Distance vision	91.7 (5.88)	95.2(4.76)	–3.47 (–5.49, –1.47)	0.001

*Independent t test, p-value < 0.05

Table V: Patients' satisfaction for near, intermediate, and distant vision and overall satisfaction using VF-14 Questionnaire

	EM (n=56)		RM (n=57)		*p-value
	S n (%)	NS n (%)	S n (%)	NS n (%)	
Overall	28 (50.0)	28 (50.0)	30 (52.6)	27 (47.4)	0.780*
Near	12 (21.4)	44 (78.6)	29 (50.9)	28 (49.1)	0.001*
Reading small print (Font 8–9)	14 (25.0)	42 (75.0)	30 (52.6)	27 (47.4)	0.003*
Reading small print (Font 10–12)	28 (50.0)	28 (50.0)	37 (64.9)	20 (35.1)	0.109*
Reading small print (Font > 14)	54 (96.4)	2 (3.6)	54 (94.7)	3 (5.3)	1.000**
Writing	37 (69.8)	16 (30.2)	44 (78.6)	12 (21.4)	0.295*
Intermediate	56 (89.3)	6 (10.7)	51 (89.5)	6 (10.5)	0.974*
Recognizing faces	54 (96.4)	2 (3.6)	55 (96.5)	2 (3.5)	1.00*
Climbing stairs	52 (50)	28 (92.9)	56 (98.2)	1 (1.8)	0.26*
Sewing, knitting	46 (92.0)	4 (8.0)	52 (94.5)	3 (5.5)	0.706*
Recognizing money	54 (96.4)	2 (3.6)	52 (91.2)	5 (8.8)	0.438*
Cooking	52 (92.9)	4 (7.1)	56 (98.2)	1 (1.8)	0.164*
Distance	28 (50.0)	28 (50.0)	24 (42.1)	33 (57.9)	0.400*
Reading signboard	34 (60.7)	22 (39.3)	26 (45.0)	31 (54.4)	0.108*
Gardening	46 (93.9)	3 (6.1)	53 (94.6)	3 (5.4)	1.00*
Watching TV	48 (95.7)	8 (14.3)	50 (87.7)	7 (12.3)	0.753*
Driving (day)	19 (65.5)	10 (34.5)	22 (68.8)	10 (31.2)	0.788*
Driving (night)	1 (34.4)	28 (96.0)	4 (12.5)	28 (87.5)	0.357*

EM: Predicted emmetropia; RM: Predicted residual myopia
S: satisfactory; NS: non-satisfactory
*Pearson's chi-squared test, p value < 0.05
**Fisher's Exact test, p value < 0.05

Demographic data
Sex, race, education level and type of occupation among the EM and LM groups were compared, and no significant differences were found (Table I).

Distance and near vision
Out of 113 patients, 7 patients (12.5%) from the EM group obtained a LogMAR of 0.0, while no patient from the RM group obtained a LogMAR of 0.0 (Table II). Thirty-six patients (64.3%) in the EM group and 30 patients (52.6%) in the RM group obtained a LogMAR of 0.0–0.3 (p = 0.209). However, 50 patients (87.7%) from the RM group gained satisfactory near vision, compared to only 27 patients (48.2%) from the EM group (p < 0.05).

Predictive and residual refractive power
Table III shows the comparison of predictive and residual refractive power between the EM and LM groups. Predictive and residual post op is lower in RM compared to EM group. This shows that the 2 groups were significantly different, a fact achieved by the randomisation process. Therefore, the 2 group would be valid for the subsequent evaluation of QOL questionnaire. The two predicted refractive power groups were significantly distinct by the randomisation process. The mean actual refractive power for the EM group was –0.39 D (SD 0.31), which was lower than that of the RM group (–0.78 D, SD 0.30; p < 0.05).

QOL
The VF-14 scores among the EM and RM groups ranged from 86.1 to 100.0, with a mean score of 94.8 (SD 2.95), skewed toward the higher score chart. Only five patients (4.4%) scored less than 90.01. At least 50% of the patients from each group scored more than 95.00. The mean VF-14 score in the EM group was 94.5 (SD 2.68), while the mean VF-14 score in the RM group was 95.1 (SD 3.19), a difference which was not statistically significant (p = 0.286). Female patients scored significantly higher than males for total activities (p = 0.010) and distance vision-related activities (p = 0.001), as shown in Table IV.

Patient's vision satisfaction
Comparisons between the EM and RM groups for near, intermediate, distance and overall vision satisfaction were evaluated using the VF-14 questionnaire, as demonstrated in Table V. The RM group had better patient satisfaction in near vision-related activities than the EM group (p = 0.001). In particular, the item 'reading small print (font size 8–9)' was better in the RM group (p = 0.003). The comparison between intermediate, distance and overall vision activities was not significantly different (p = 0.974, p = 0.400 and p = 0.780, respectively).

DISCUSSION

Our study indicated that a significant numbers of RM patients gained satisfactory near vision following monofocal IOL implantation, which was translated into significantly better QOL in near vision-related activities on the VF-14 questionnaire, especially regarding reading small print (font size 8–9). This finding is comparable with a previous study, which also showed good vision in cases of mild myopia following cataract surgery.[18] Previous published reports regarding post-operative spectacles dependence also suggested that patients with RM can be independent from wearing glasses.[19]

The ability to have good near vision was very important in our cohort of patients. Approximately 85% of patients were elderly Malay Muslims who are enthusiasts in learning and reading the Quran daily. In this social setting, a rural area in northeast Malaysia, elderly people live with their children, and most of their needs are taken care of by their offspring. Elderly females commonly stay indoors as compared to their male counterparts. In our study, males and females were equally distributed, whereas a female predominance (62%) was noted in a previous study conducted in Auckland.[20] We compared the VF-14 scores between the female and male patients in our study and found that there was a statistically significant difference in the VF-14 scores between males and females. This difference can probably be attributed to the gender-related activities listed in the questionnaire. The questions about sewing and knitting revealed 105 responses since males do not perform needlework. The questions about driving had 61 responses, which were mainly from male patients. This probably contributed to the low satisfaction rates for distance vision in both EM and RM groups.

Earlier study evaluated that the impact of visual impairment on health-related QOL in a cohort of persons over the age of 64 demonstrated contrary mean VF-14 values between the sexes. The mean VF-14 score using the original version was consistently inferior for women than for men for all categories of visual acuity.[21]

Literature review has shown the importance of predictive refractive power in patients with normal axial length undergoing uneventful phacoemulsification surgery and their visual acuity outcome.[22,23] In our study, we found statistically significant differences for both groups predictive and residual refractive power. This suggests that we are evaluating patients in two distinct groups. At 3 months post-operatively, both groups gained unaided distant vision ranging from LogMAR 0.0 to 0.7. The predictive refractive power in previous studies[17,22] was comparable to that of the EM group in our study. Improvements in visual function and QOL have been demonstrated following cataract surgery.[24-27]

Other reports have observed improvements in the various domains of QOL.28 VF-14 questionnaires have been extensively used to assess QOL[15,17,26,29] and the VF-14 questionnaire has been translated into various languages, including Arabic,[17] Dutch,[30] German[31] and Bahasa Malaysia.[15] The questionnaire in this study were administered 3 months after the surgery to allow for proper healing and for stabilisation of astigmatism. Subjective refraction was performed within 10 to 12 weeks post-operatively, allowing for a more appropriate assessment of the gains that patients were likely to achieve.[25] The gains in visual function related to QOL are apparent within 4 months of cataract surgery.[25]

Modified VF-14 questionnaires were used to assess the vision-related QOL in our study. The use of other patient-reported outcome questionnaires may help to evaluate QOL following cataract surgery.[12] Newer questionnaires may be able to explore the signs and symptoms that are demonstrated in pseudophakia. There are suggestions that reading speed should be incorporated as a parameter to evaluate reading performance, as well as reading acuity, distance reading, near reading and reading small print.[32] The results of this study are tailored to the needs of the local community.

CONCLUSION

The modified Bahasa Malaysia version of VF-14 QOL questionnaire was successfully used in this study to evaluate functional vision in post-operative cataract patients implanted with monofocal IOL. Both EM and RM patients gave high scores on the QOL questionnaire. However, predicted RM achieved more satisfactory near vision and near vision-related activities compared to EM. Monofocal IOL implantation is a cheaper alternative to multifocal IOL and it is a highly acceptable choice measured by QOL suited to the local population's routine QOL activities. A newer questionnaire could be constructed to explore other relevant post-operative visual functions and activities. This study was limited by its sample size and may not be applicable to a wider general population. A longer follow-up period (e.g. up to 6 months post-operatively) would provide more comprehensive QOL data interpretation.

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CONFLICTS OF INTEREST/COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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