

Visual quality analysis of high myopia with posterior staphyloma after cataract surgery

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Abstract

• **AIM:** To evaluate the visual quality of cataract patients of high myopia with posterior staphyloma after phacoemulsification and intraocular lens (IOL) implantation, and analyze the reasons.

• **METHODS:** This study comprised cataract patients of high myopia with posterior staphyloma (Group A) and cataract patients of high myopia without posterior staphyloma (Group B) and cataract patients of emmetropia (Group C) . Postoperative visual function, including uncorrected distance visual acuity (UCDVA) and best-corrected distance visual acuity (BCDVA) were evaluated 3 days and 6 months postoperatively. Contrast sensitivity, funduscopy and patients' self satisfaction in the 3 groups were also compared. The relationship of vision and the axial length was also evaluated in Group A.

• **RESULTS:** Of the 545 eyes, 91 eyes were in the Group A and 227 eyes were both in Group B and C. The Group B and C had statistically significant better UCDVA and BCDVA than Group A from 3 days postoperatively to the final follow-up (both $P < 0.05$). Group C had statistically significant better UCDVA and BCDVA than Group B at 3 days postoperatively ($P < 0.05$). There were no statistically significant differences in UCDVA or BCDVA between Group B and C at 6 months postoperatively. The Group C had statistically significantly better contrast sensitivity than Group A and B; Group B had statistically significantly better contrast sensitivity than Group A (all $P < 0.05$). After statistical test, it was testified that there was negative correlation between axis length of eye and postoperative vision in cataract patients of high myopia with posterior staphyloma. Patients in Group A and B reported being more satisfied than those in Group C (both $P < 0.05$), but there were no significant differences between Group A and B.

• **CONCLUSION:** The visual quality of cataract patients of high myopia with posterior staphyloma after phacoemulsification and IOL implantation is worse than that of high myopia without posterior staphyloma and emmetropia. It is directly related to the posterior segment pathological changes in high myopia.

• **KEYWORDS:** highly myopic; posterior staphyloma; phacoemulsification

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INTRODUCTION

Myopia is the most prevalent illness in human eye disease. There is about 25% of adults suffer from myopia in America^[1]. The proportion in China is more than 50%^[2], and pathological myopia presented in 1% of the total population^[3]. With the increasing of civilization and acceleration of aging, the ratio of high myopia with posterior staphyloma in cataract patients gradually increases. These patients' corrected visual acuity is difficult to improve because of increasing axial length of eyeball. More and more ophthalmologists concerned with their postoperative visual quality. In this study, we compared visual function between high myopia with posterior staphyloma and high myopia without posterior staphyloma and emmetropia after cataract surgery in a large patient cohort, and comprehensively analyzed the postoperative visual quality.

MATERIALS AND METHODS

Materials This retrospective study comprised eyes of cataract patients who had phacoemulsification with implantation of intraocular lens(IOL) between October 2006 and March 2011 at the Affiliated Hospital of Qingdao University Medical College. The University of Qingdao's ethics committee approved the study protocol, and the enrollment and informed consent procedure were in accordance with the tenets of the Declaration of Helsinki.

Inclusion criteria were being diagnosed with age-related cataracts, blood pressure and blood glucose within the allowable range in surgery, nuclear hardness from grade II to IV on the Emery-Little classification, corneal astigmatism less than 1.00 diopters (D), corneal endothelium cell count greater than 2000 cells/mm², and the ability to understand and sign an informed consent form. Exclusion criteria included history of amblyopia, fundus abnormalities that could cause significant vision impairment, previous intraocular surgery, ocular comorbidity (eg, glaucoma, previous trauma, macular disease, diabetic retinopathy, pseudoexfoliation syndrome, chronic uveitis, corneal opacity, and so on). Intraoperative exclusion criteria were vitreous loss, and IOL implantation outside the capsular bag.

Table 1 Preoperative characteristics of patients

Parameter	Group A	Group B	Group C	t_{AB}	t_{AC}
Eyes (n)	91	227	227	-	-
Age (y)	65±7.72	66±6.89	67±7.43	0.15	0.17
Sex (m/f)	47:44	118:109	116:111	0.029(Chi-square test)	0.035(Chi-square test)
Mean astigmatism (D)	0.62±0.65	0.58±0.41	0.52±0.38	0.29	0.34

Table 2 The comparison of UCDVA and BCDVA in 3 groups at 3 days postoperatively

Vision	Group A		Group B		Group C	
	UCDVA	BCDVA	UCDVA	BCDVA	UCDVA	BCDVA
<0.05	8	2	5	3	0	0
0.05-<0.3	31	22	35	16	0	0
0.3-<0.5	17	19	40	29	6	2
0.5-<0.8	17	20	61	53	63	55
≥0.8	18	28	86	126	158	170
P Value	$P_{AB}<0.05$	$P_{AB}<0.05$	$P_{BC}<0.05$	$P_{BC}<0.05$	$P_{AC}<0.05$	$P_{AC}<0.05$

According to the preoperative refractive status and fundus examination and the posterior staphyloma, the enrolled patients were divided into 3 groups; Group A was cataract patients of high myopia with posterior staphyloma; Group B was cataract patients of high myopia without posterior staphyloma; Group C was cataract patients of emmetropia. The diagnostic criteria of posterior staphyloma was the depth of the eye rear protruding $\geq 2\text{mm}$ [4,5] in this paper.

Methods IOL power was calculated based on the axial length (AL) and corneal curvature. The SRK/T formula was used for an AL between 22.0mm and 26.0mm [6], and the Holladay formula for an AL greater than 26.0mm [7]. The all enrolled patients had implantation of a monofocal IOL (AcrySof SN60WF, Alcon, Inc.), which is a blue light filtering aspherical foldable single-piece IOL. All phacoemulsification with IOL implantation surgery were performed by the same surgeon. Corneal tunnel incisions of 3.0mm were created based on preoperative corneal curvature, and a central continuous curvilinear capsulorhexis was made. After phacoemulsification, the IOL was implanted with a cartridge (Monarch II, Alcon, Inc.).

All patients were followed up for 6 months. Visual function was assessed by uncorrected distance visual acuity (UCDVA), best-corrected distance visual acuity (BCDVA) and contrast sensitivity. Patients' UCDVA and BCDVA were examined preoperatively and 3 days, 6 months postoperatively. The UCDVA and BCDVA were measured monocularly using Snellen charts with Sloan optotypes at 5m. All visual acuity scores were recorded in LogMAR units. Postoperative contrast sensitivity was determined using the Vision Contrast Test System-6500 (Vistech Consultants, Inc.). We measured the contrast sensitivity of the 3 groups by distant corrected monocular photopic vision ($85\text{cd}/\text{m}^2$) and scotopic vision ($3\text{cd}/\text{m}^2$) under the five kinds of spatial frequency. This five spatial frequencies were 1.5, 3.0, 6.0, 12.0, 18.0 (cycle/degree, c/d). The results was drawn by the base 10 logarithm for statistical analysis. B-ultrasound were used for observation, not for statistical indicators. Patients' self

satisfaction was evaluated using a 5-point scale ranging from 1 (very dissatisfied) to 5 (very satisfied) [8].

Statistical Analysis Statistical analysis was performed by SPSS 17.0. Pearson Chi-square test or Fisher exact probabilities were used to compare visual acuities among the 3 groups. Univariate analysis of variance (ANOVA) and least significant difference were used to contrast sensitivity and patients' satisfaction scores. When a normal distribution was not expected (eg, satisfaction scores), the Kruskal-Wallis test was used. The relationship between vision and the AL in Group A was analyzed using linear regression analysis. Results were expressed as means \pm standard deviation. A 2-tailed P value less than 0.05 was considered statistically significant.

RESULTS

The study enrolled 545 eyes of 472 patients. Table 1 showed the patients' preoperative characteristics. There were no statistically significant differences in age, the ratio of men to women, and mean astigmatism among the 3 groups (all $P<0.05$). Table 2 and Table 3 showed the distance visual acuities by group. The Group C had statistically significant better UCDVA and BCDVA than the Group A and B at 3 days postoperatively (both $P < 0.05$). The Group B had statistically significant better UCDVA and BCDVA than the Group A at 3 days postoperatively (both $P < 0.05$). The Group B and C had statistically significant better UCDVA and BCDVA than the Group A at 6 months postoperatively (both $P < 0.05$). There were no statistically significant differences in UCDVA or BCDVA between the Group B and C over the 6-month follow-up.

Table 4 showed the contrast sensitivity by group. In five spatial frequencies of the four states, the Group C had statistically significantly better contrast sensitivity than the Group A and B; the Group B had statistically significantly better contrast sensitivity than the Group A (all $P < 0.05$). The contrast sensitivity reduced obviously in high spatial frequency (18c/d, 12c/d) of scotopic glare-free and medium and high spatial frequency (18c/d, 12c/d, 6c/d) of scotopic glare of the postoperative residual in Group A.

Table 3 Comparison of UCDVA and BCDVA in 3 groups at 6 months postoperatively

Vision	Group A		Group B		Group C	
	UCDVA	BCDVA	UCDVA	BCDVA	UCDVA	BCDVA
<0.05	3	2	1	0	0	0
0.05-<0.3	9	9	1	1	0	0
0.3-<0.5	7	8	4	2	0	0
0.5-<0.8	18	11	29	18	21	18
≥0.8	54	62	192	205	206	209
<i>P</i> Value	$P_{AB}<0.05$	$P_{AB}<0.05$	$P_{BC}>0.05$	$P_{BC}>0.05$	$P_{AC}<0.05$	$P_{AC}<0.05$

Table 4 Comparison of contrast sensitivity in different spatial frequency postoperatively $\bar{x} \pm s$

Group	Number of eyes	Photopic glare-free					Photopic glare				
		1.5c/d	3.0c/d	6.0c/d	12.0c/d	18.0c/d	1.5c/d	3.0c/d	6.0c/d	12.0c/d	18.0c/d
A	91	1.41±0.02	1.43±0.05	1.57±0.04	1.48±0.04	0.53±0.06	1.37±0.08	1.41±0.03	1.53±0.02	1.29±0.03	0.44±0.09
B	227	1.62±0.03	1.68±0.02	1.91±0.05	1.73±0.04	0.76±0.07	1.65±0.12	1.77±0.04	1.71±0.01	1.45±0.06	0.63±0.02
C	227	2.08±0.06	1.92±0.02	2.09±0.07	1.94±0.05	0.92±0.03	1.94±0.05	1.90±0.02	1.88±0.07	1.76±0.01	0.81±0.06

Group	Number of eyes	Scotopic glare-free					Scotopic glare				
		1.5c/d	3.0c/d	6.0c/d	12.0c/d	18.0c/d	1.5c/d	3.0c/d	6.0c/d	12.0c/d	18.0c/d
A	91	1.17±0.03	1.14±0.04	1.23±0.07	0.48±1.13	0.00±0.00	0.62±0.09	0.71±0.13	0.21±0.08	0.04±0.00	0.00±0.00
B	227	1.46±0.11	1.63±0.12	1.68±0.05	1.39±0.01	0.51±0.06	0.93±0.13	1.07±0.09	1.01±0.03	0.85±0.05	0.48±0.06
C	227	1.78±0.09	1.86±0.07	1.82±0.02	1.64±0.03	0.76±0.06	1.15±0.07	1.27±1.10	1.38±0.02	1.04±0.07	0.69±0.02

Table 5 The relationship of vision and axial length in Group A at 6 months postoperatively

Vision	Axial length (mm)											
	24	25	26	27	28	29	30	31	32	33	34	
<0.05	0	0	0	0	0	0	0	1	0	0	1	
0.05-<0.3	0	0	1	1	2	3	1	1	0	0	0	
0.3-<0.5	0	0	2	3	0	2	1	0	0	0	0	
0.5-<0.8	0	2	2	2	1	3	1	0	0	0	0	
≥0.8	6	4	7	13	19	11	1	0	1	0	0	

Table 6 The patients' self satisfaction at 6 months postoperatively

Groups	Very dissatisfied 1	Basically dissatisfied 2	General 3	Basically satisfied 4	Very satisfied 5	Average	<i>P</i> Value
Group A	1	3	11	17	59	4.43	$P_{AB}>0.05$
Group B	2	9	21	37	158	4.50	$P_{BC}<0.05$
Group C	7	13	67	97	43	3.69	$P_{AC}<0.05$

Table 5 showed the relationship of vision and the AL in Group A. In the 91 eyes of high myopia with posterior staphyloma, 2 patients (2.2%) whose BCDVA were below 0.05 were still blind. 9 patients (9.9%) whose BCDVA were in 0.05 to 0.3 were in the range of low vision. 73 patients (80.2%) whose BCDVA were not less than 0.5 had better effect of surgery. After statistical test, it was testified that there was negative correlation between axis length of eye and postoperative vision in cataract patients of high myopia with posterior staphyloma.

Table 6 showed the patients' self satisfaction in the 3 groups at 6 months postoperatively. Patients in Group A and B reported being more satisfied than those in Group C (both $P<0.05$), but there were no significant differences between the Group A and B. In Group C, patients were satisfied with watching TV, driving, outdoor exercises, but they lowered the satisfaction in reading books, painting, writing, and using computer. Patients' overall satisfaction in Group A and B were higher than that in Group C. 37 percent of patients in Group A and B

had the symptom of asthenopia (eg, headache, sore eyes and dry eyes) when they gazed in a short time.

DISCUSSION

Pathological myopia (PM) is often accompanied by morphological changes of the eye posterior pole, including the thinner sclera, chorioretinal atrophy, and the growth of AL. The complications of pathological myopia are common in posterior staphyloma, retinal detachment, macular schisis, and macular epiretinal membrane. With the increasing of the diopter, vision can not be easily corrected, and it directly relates to fundus lesions of high myopia. In a series of interrelated degenerative changes in high myopia posterior, staphyloma is the based lesion.

In our study, the UCDVA and BCDVA of cataract patients of high myopia with posterior staphyloma after phacoemulsification was significantly lower than that of high myopia without posterior staphyloma, but there was no significant difference in diopter, age, and AL between the two groups. It suggests that high myopia with posterior staphyloma is likely to be the

most significant causes of affecting postoperative visual acuity of patients. These findings agree with those in other studies in which high myopia without posterior staphyloma yielded significant BCDVA than high myopia with posterior staphyloma^[9]. Some of studies^[10-12] have pointed out that chorioretinal atrophy is the pathological basis of posterior staphyloma. The most fundus lesions of high myopia led to abnormal changes of choroid vascular building and poor blood perfusion of the choroidal vessel in lesion area. Thus, the corrected visual acuity of patients with posterior staphyloma can not be improved. The corrected visual acuity of high myopia mainly depends on the type and extent of lesion on posterior pole of eyeball^[13,14].

Contrast sensitivity in our high myopia with posterior staphyloma group was slightly lower than that in high myopia without posterior staphyloma group, and obviously lower than that in emmetropia group. In our study, we also found the contrast sensitivity reduced obviously in high spatial frequency of scotopic glare-free and medium and high spatial frequency of scotopic glare in high myopia with posterior staphyloma group. This result agrees with previously reported findings^[15]. Contrast sensitivity decreases in cataract patients of high myopia with posterior staphyloma after phacoemulsification and intraocular lens implantation, and it reduces more obvious in the dim light at night because of decreasing incident light. The decrease in contrast was clinically significant and had significant adverse effect on the patients' quality of life. We suspect the decrease of contrast sensitivity may be caused by the fundus changes in high myopia.

In the research of relationship of vision and AL in high myopia with posterior staphyloma at 6 months postoperatively, we summarized that the axis length of eye was negatively correlated with postoperative vision in cataract patients of high myopia with posterior staphyloma. We detected AL of 91 patients with posterior staphyloma were all longer than 24mm, and the shortest one was 24.71mm, the longest one is 34.12mm. With the AL increasing, there are significant differences in thickness of macula lutea between high myopia with posterior staphyloma group and high myopia without posterior staphyloma group. By the action of intraocular pressure, posterior sclera is stretched passively. At the same time, retina is also stretched passively with the diopter and AL increasing, and it becomes more thin.

In our study, the arc spot of optic disc appeared in all fundus of posterior staphyloma which we had observed. Besides, we found most of posterior staphyloma is expansion to the outside rear. Previous studies^[16] reported that the more diopter increased, the more atrophic area of optic disc enlarged. The incidence of posterior staphyloma in high myopia had close connection with diopter and AL, and the posterior staphyloma made visual function more worse. We found the most posterior staphyloma in Group A was located on posterior pole, especially expanded to temporal side. It is in accordance with clinical characteristics of high myopia. For example, the location of retinal tear in high myopia is common in temporal

side, and the location of arc spot of optic papilla is common in temporal side.

We observed visual acuity, contrast sensitivity and patients' self satisfaction, to evaluate the effect of visual quality of cataract patients of high myopia with posterior staphyloma after phacoemulsification and IOL implantation. In conclusion, it is worse than the cataract patients of high myopia without posterior staphyloma and the cataract patients of emmetropia. To some extent, the cataract patients of high myopia with posterior staphyloma got more satisfaction of visual quality postoperatively. However, because of the fundus lesions of high myopia, especially with macular pathologies, many patients are not able to achieve the ideal visual acuity, and even some patients are still blind. Thus, the patients' quality of life can not be improved. How to prevent and control fundus lesions of high myopia, and improve the surgical results will be researched in further studies.

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高度近视伴后巩膜葡萄肿超声乳化术后视觉质量分析

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摘要

目的:评价高度近视伴后巩膜葡萄肿的白内障患者行白内障超声乳化摘除联合人工晶状体(intraocular lens, IOL)植入术后的视觉质量,并分析其原因。

方法:本研究根据患者术前屈光状态以及有无后巩膜葡萄肿分为三组:A组为高度近视伴有后巩膜葡萄肿的白内障患者;B组为高度近视无后巩膜葡萄肿的白内障患者;C组为正视眼的白内障患者。于手术后3d观察A、B、C三组裸眼远视力(uncorrected distance visual acuity, UCDVA)

和最佳矫正远视力(best-corrected distance visual acuity, BCDVA),术后6mo观察A组视力与眼轴的关系、A、B、C三组UCDVA和BCDVA、对比敏感度、眼底检查及患者术后满意度调查。

结果:在本实验收集的472例患者(545眼)中,A组患者74例(91眼);B、C组各199例(227眼)。术后3d及6mo,B、C组的UCDVA及BCDVA均优于A组,差异有统计学意义(均 $P<0.05$);术后3d,C组的裸眼远视力及最佳矫正远视力优于B组,差异有统计学意义($P<0.05$);术后6mo患者UCDVA及BCDVA在B、C两组间的差异无统计学意义。A组和B组在4种状态5种空间频率下的对比敏感度的差异均有统计学意义(均 $P<0.05$),C组的对比敏感度高于A、B组,B组的对比敏感度要高于A组,差异有统计学意义(均 $P<0.05$)。经统计学检验,高度近视伴后巩膜葡萄肿白内障患者超声乳化术后视力与眼轴长短之间呈负相关性。A、B组患者术后视觉质量满意度高于C组,差异有统计学意义(均 $P<0.05$),但A、B组间患者术后质量满意度无明显差异。

结论:高度近视伴后巩膜葡萄肿的白内障患者行白内障超声乳化摘除联合IOL植入术后的视觉质量较高度近视不伴有后巩膜葡萄肿的白内障及正视眼的白内障患者差,这与高度近视眼底病变有直接关系。

关键词:高度近视;后巩膜葡萄肿;白内障超声乳化术