Clinical outcomes of cataract surgery with implantation of extended depth of focus intraocular lenses

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Abstract

Background: Cataract is a leading cause of blindness in Vietnam and worldwide. Phacoemulsification with extended depth of focus intraocular lenses helps patients achieve their desired vision in distance and intermediate vision, improve near vision, and minimize phenomena such as halos and glare. **Objectives:** To evaluate the clinical outcomes of cataract surgery with implantation of extended depth of focus intraocular lenses. **Subjects and Methods:** A prospective interventional clinical study was conducted on 57 eyes of 50 cataract patients who underwent phacoemulsification with implantation of the extended depth of focus intraocular lenses. **Results**: At 3 months after surgery, the uncorrected and corrected distance visual acuity (logMAR) were 0.07 ± 0.07 and 0.06 ± 0.06; The uncorrected and corrected intermediate visual acuity (logMAR) were 0.26 ± 0.12 and 0.25 ± 013; The uncorrected and corrected near visual acuity (logMAR) were 0.55 ± 0.20 and 0.54 ± 0.19; Most patients did not experience symptoms of halos and glare. Satisfaction rates were high, with 94.7% of patients reporting satisfaction or high satisfaction with the surgery. **Conclusion:** Phacoemulsification with extended depth of extended depth of focus intraocular lenses yields high efficacy in terms of visual acuity and patient satisfaction.

Keywords: *Phaco, IOL, EDOF (extended depth of focus), cataract.*

1. INTRODUCTION

Cataract is a leading cause of blindness in Vietnam as well as in numerous countries worldwide [1]. According to the World Health Organization's 2020 data, there are over 20 million individuals blind due to cataracts globally, accounting for 51% of blindness worldwide, with an estimated increase to nearly 40 million by 2025 [2]. The advent of phacoemulsification surgery represents a significant milestone in the treatment of cataracts [3].

The selection of intraocular lenses depends on the biometric characteristics of the eye, visual expectations, and patient needs. Intermediate vision has become increasingly important for daily activities such as computer and mobile phone use [4]. Phacoemulsification surgery with extended depth of focus intraocular lenses implantation improves intermediate vision for various daily tasks while maintaining good quality distance vision. Furthermore, it does not induce unwanted optical phenomena. [5]. The purpose of this study was to evaluate the clinical outcomes of cataract surgery with implantation of extended depth of focus intraocular lenses.

2. SUBJECTS AND METHODS

2.1. Subjects

57 eyes from 50 patients diagnosed with cataracts and indicated for phacoemulsification surgery with extended depth of focus intraocular lenses implantation were included. This study was conducted at the Hue Central Hospital Eye Center from March 2023 to November 2023.

Inclusion criteria:

Patients with cataracts presented with visual acuity < 20/25 (Snellen chart), good light perception in all directions, IOP ≤ 21 mmHg, and astigmatism < 1 D.

Patients who agreed to participate in the study and were cooperative.

Exclusion criteria:

Patients with a history of ocular diseases affecting transparency, severe myopia, uveitis, glaucoma, optic nerve disorders, corneal diseases, diabetic retinopathy, retinal detachment, age-related macular degeneration, or ocular trauma.

Patients with inadequate pupil dilation (< 4mm), history of refractive surgery or corneal surgery.

Patients with severe systemic diseases that could

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affect their ability to participate in examinations and follow-up visits, such as advanced age, frailty, or mental disorders.

2.2. Study method

2.2.1. Study design

Prospective interventional clinical study.

2.2.2. Preoperative Evaluation

Patients underwent assessments of visual acuity, IOP, and anterior and posterior segment clinical examination.

Evaluation of the cataract type, nuclear cataract grading, measurement of axial length, and assessment of astigmatism were performed. The power of the IOL was calculated using the Barrett Universal II Formula, and the appropriate IOL power was selected for each patient [6], [7].

2.2.3. Surgical Procedure

The surgical procedure involved the following steps: (1) anesthesia, (2) prepping, draping, and the microscope's setup, (3) the incision, (4) the capsulorhexis, (5) nuclear disassembly, (6) cortical cleanup, (7) implantation of the extended depth of focus intraocular lenses, and (8) closure of the incision.

2.2.4. Postoperative Follow-up

Patients are provided with instructions regarding ocular care, medication administration, and the utilization of protective eyewear. Systemic antibiotics and anti-inflammatories were prescribed for a duration of 7 days, antibiotic and anti-inflammatory eye drops administered six times daily for one month. Patients were subsequently monitored at 1 day, 1 week, 1 month, and 3 months postoperatively:

- Uncorrected distance, intermediate, and near visual acuity.
- Corrected distance, intermediate, and near visual acuity.
- Spectacle independence. Spectacle independence is defined as the ability to perform a range of daily visual tasks, including distance, intermediate, and near activities, without the need for corrective eyewear, following cataract surgery with IOL.
- Incidence of undesirable visual symptoms such as halos and glare.
- Patient satisfaction

2.2.5. Data analysis:

The research results were processed using SPSS 20 statistical software. The data were presented as mean values (±) standard deviation. Chi-square test and Paired t-test were used. The p-value was considered significant when $p<0.05$.

3. RESULT

3.1. General characteristics of research subjects

Table 1. General characteristics of research subjects (n=57)

Variables		n	%
Age	≤ 60	20	35.1
	> 60	37	64.9
	Mean	64.6 ± 10.9	
Gender	Male	18	31.6
	Female	39	68.4
Visual acuity	Uncorrected distance visual acuity	0.89 ± 0.21	
	Corrected distance visual acuity	0.75 ± 0.23	
Type of cataract	Nuclear sclerotic cataract	46	80.7
	Cortical cataract	06	10.5
	Posterior subcapsular cataract	05	8.8
Nuclear cataract grading	Grade 2	5	8.8
	Grade 3	41	71.9
	Grade 4	11	19.3

The average age of patients was 64.6 ± 10.9 years; 35.1% of patients were aged ≤ 60, while 64.9% were aged > 60. The proportion of male and female patients was 31.6% and 68.4%, respectively. Preoperative uncorrected and corrected distance visual acuity measured in logMAR were 0.89 ± 0.21 and 0.75 ± 0.23, respectively.

Among 57 eyes, nuclear sclerotic cataract was observed in 46 eyes (80.7%), cortical cataract in 6 eyes (10.5%), and posterior subcapsular cataract in 5

eyes (8.8%). Regarding nuclear cataract grading, 5 eyes had grade 2 (8.8%), 41 eyes had grade 3 (71.9%), and 11 eyes had grade 4 (19.3%).

3.2. Surgical Outcomes

3.2.1. Postoperative visual acuity

3.2.1.1. Uncorrected and Corrected distance visual acuity

Table 2. Uncorrected and Corrected distance visual acuity at various time points (n = 57)

Time points / LogMAR visual acuity	Postoperation			
	1 day	1 week	1 month	3 months
Uncorrected distance visual acuity	0.15 ± 0.12	0.14 ± 0.09	0.10 ± 0.09	0.07 ± 0.07
Corrected distance visual acuity			0.09 ± 0.10	0.06 ± 0.06

The uncorrected distance visual acuity at one day postoperatively was 0.15 ± 0.12; at one week postoperatively was 0.14 ± 0.09; and at one and three months postoperatively was 0.10 ± 0.09 and 0.07 ± 0.07, respectively. The corrected distance visual acuity in logMAR at one and three months postoperatively was 0.09 ± 0.10 and 0.06 ± 0.06, respectively.

3.2.1.2. Uncorrected and Corrected Intermediate Visual Acuity

Table 3. Uncorrected and Corrected Intermediate Visual Acuity at various time points (n = 57)

Time / LogMAR Visual Acuity	Postoperation			
	1 day	1 week	1 month	3 months
Uncorrected intermediate visual acuity	0.38 ± 0.23	0.32 ± 0.19	0.28 ± 0.15	0.26 ± 0.12
Corrected intermediate visual acuity			0.26 ± 0.13	0.25 ± 0·13

Uncorrected intermediate visual acuity at one day, one week, one month, and three months postoperatively was 0.38 ± 0.23; 0.32 ± 0.19; 0.28 ± 0.15; and 0.26 ± 0.12, respectively. The corrected intermediate visual acuity at one and three months postoperatively was 0.26 ± 0.13 and 0.25 ± 0.13, respectively.

3.2.1.3. Near visual acuity postoperatively

Table 4. Uncorrected and Corrected near visual acuity at various time points (n = 57)

Time points / LogMAR visual acuity	Postoperation			
	1 day	1 week	1 month	3 months
Uncorrected near visual acuity	0.62 ± 0.13	0.59 ± 0.17	0.56 ± 0.19	0.55 ± 0.20
Corrected near visual acuity			0.54 ± 0.20	0.54 ± 0·19

Uncorrected near visual acuity at one day, one week, one month, and three months postoperatively was 0.62 ± 0.13; 0.59 ± 0.17; 0.56 ± 0.19; and 0.55 ± 0.20, respectively. Corrected near Visual acuity at one and three months postoperatively was 0.54 ± 0.20 and 0.54 ± 0.19, respectively.

3.2.2. Spectacle independence after surgery

Table 5. Spectacle independence after surgery (n = 57)

Visual Acuity	Time points	Spectacle independence		Spectacle dependence	
		N	%	n	%
Distance Visual Acuity	1 month	55	96.5	2	3.5
	3 months	55	96.5	2	3.5
Intermediate Visual Acuity	1 month	47	82.5	10	17.5
	3 months	48	84.2	09	15.8
Near Visual Acuity	1 month	9	15.8	48	84.2
	3 months	10	17.5	47	82.5

The percentage of patients with spectacle independence for distance vision at one and three months postoperatively was 96.5%. The percentage of patients with spectacle independence for intermediate vision at one and three months postoperatively was 82.5% and 84.2%, respectively. The percentage of patients with spectacle independence for near vision at one and three months postoperatively was 15.8% and 17.5%, respectively.

3.2.3. Patient satisfaction after surgery

Table 6. Patient satisfaction after surgery (n = 57)

Time points	Very satisfied		Satisfied		Not satisfied	
	n	%	n	%	n	%
1 month	39	68.4	14	24.6	4	7
3 months	42	73.7	12	21.0	3	5.3

The percentage of patients satisfied and very satisfied after surgery at one and three months postoperatively is 93% and 94.7%, respectively.

3.2.4. Postoperative adverse symptoms

Table 7. Postoperative adverse symptoms (n = 57)

Time points	Postoperative adverse symptoms	None		Mild		Moderate	
		n	%	n	%	n	%
1 month	**Halo**	52	91.2	4	7	1	1.8
	Glare	53	92.9	3	5.3	1	1.8
3 months	**Halo**	54	94.7	3	5.3	0	0
	Glare	54	94.7	3	5.3	0	0

At one month postoperatively, the percentage of patients without halo and glare was 91.2% and 92.9%, respectively; the percentage with mild halo and glare was 7% and 5.3%, respectively. At three months postoperatively, 94.7% of patients did not experience halo and glare; 5.3% experienced mild halo and glare; there were no patients with moderate-level halo and glare symptoms.

4. DISCUSSION

Based on the follow-up of 57 eyes from 50 patients who underwent cataract surgery with implantation of extended depth of focus intraocular lenses from March 2023 to November 2023, we have several discussions as follows:

General characteristics of research subjects: The average age in our study was 64.6 ± 10.9, which is quite similar to the findings of Nguyen Thi Huyen Trang: 65.2 ± 9.6 [11] and Y J Jeon: 65.2 ± 8.2 [12]. However, it is lower compared to studies by authors such as R Mencucci: 72.31 ± 6.71 [13]; Ang RET: 69.9 ± 7.2 [14].

Preoperative visual acuity: In our study, the preoperative uncorrected distance visual acuity and corrected distance visual acuity were 0.89 ± 0.21 and 0.75 ± 0.23, respectively. This visual acuity was lower compared to Nguyen Thi Huyen Trang 0.86 ± 0.16 [11]; Y J Jeon: 0.55 ± 0.35; 0.33 ± 0.32 [12]; R Mencucci: 0.37 ± 0.16 [13]; Ang RET: 0.49 ± 0.25 and 0.18 ± 0.19 [14].

Distance visual acuity: In our study, at the 3-month postoperative mark, the results for uncorrected distance visual acuity and corrected distance visual acuity were 0.07 ± 0.07 and 0.06 ± 0.06, respectively. Our visual acuity results were lower compared to authors such as Nguyen Thi Huyen Trang: 0.05 ± 0.03; 0.04 ± 0.06 [11]; R Mencucci: 0.04 ± 0.05; 0.02 ± 0.04 [13]; Ang RET: 0.06 ± 0.11 and -0.01 ± 0.18 [14].

Intermediate Visual Acuity: In our study, at the 3-month postoperative mark, the results for uncorrected intermediate visual acuity and corrected intermediate visual acuity were 0.26 ± 0.12 and 0.25 ± 0.13, respectively. Our visual acuity results were quite similar to those of Nguyen Thi Huyen Trang: 0.27 ± 0.14 and 0.25 ± 0.13 [11]; R Mencucci: 0.28 ± 0.15 [13]; however, they were lower than those of Ang RET: 0.17 ± 0.14 and 0.19 ± 0.12 [14].

Near visual acuity: Uncorrected near visual acuity and corrected distance visual acuity at the 3-month postoperative mark in our study were 0.55 ± 0.2 and 0.54 ± 0.19, respectively, measured in logMAR. When compared to other authors, our visual acuity results were quite similar to those of Nguyen Thi Huyen Trang: 0.55 ± 0.27 and 0.53 ± 0.24 [2]; however, they were lower than those of foreign

authors such as R Mencucci: 0.46 ± 0.13 [13].

There are differences in postoperative visual acuity results compared to other authors due to higher preoperative average visual acuity, alongside authors from countries with more developed economies, better economic conditions, and better postoperative patient care. Spectacle Independence Postoperatively: In our study, at the 3-month postoperative mark, the rates of spectacle independence for distance, intermediate, and near vision were 96.5%, 84.2%, and 17.5%, respectively. Therefore, it can be seen that phacoemulsification with implantation of extended depth of focus intraocular lenses yields good visual outcomes for distance and intermediate vision, as well as improvement in near vision.

Adverse symptoms: In our study, at the 3-month postoperative mark, 94.7% of patients did not experience bright halo symptoms, while 5.3% experienced mild halo symptoms; none of the patients experienced moderate halo symptoms. This result is quite similar to the patient satisfaction rates reported by Nguyen Thi Huyen Trang, where the percentages of mild and moderate bright halo symptoms were 3.4% and 1.8%, respectively [11]. R Mencucci and Ang RET showed that unwanted optical phenomena such as halos did not have statistically significant differences between the two groups of patients with extended depth of focus intraocular lenses and single-focus lenses implantation, with most patients not complaining about this phenomenon.

Patient satisfaction level: In our study, the patient satisfaction level at the 3-month postoperative mark was 94.7%, which is quite similar to the study by Nguyen Thi Huyen Trang, where the satisfaction rate at the 3-month mark was 95.8% [11]. This result indicates high patient satisfaction with phacoemulsification with implantation of extended depth of focus intraocular lenses. The proportion of patients dissatisfied due to spectacle dependence, halo symptoms, or postoperative edema is very low.

5. CONCLUSION

Our study results demonstrate that the majority of patients undergoing phacoemulsification with implantation of extended depth of focus intraocular lenses achieve good distance and intermediate vision, along with improved near vision. The rate of patients achieving spectacle independence postoperatively is high, particularly for distance and intermediate vision. Adverse symptoms such as halos are rare and generally mild. Patient satisfaction with the treatment outcomes is high.

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