ORIGINAL RESEARCH

Improvement of UCVA, BCVA, and Intraocular Pressure after Phakic Posterior Chamber Intraocular Lens Implantation for Myopia

Qing Pan, MM; Shi Zhou, MM; Haijing Cao, MM; Chaopeng Li, MD

ABSTRACT

Objective • The purpose of this study is to explore the artificial lens planting of the back room shape of the crystal eye eyes and The clinical effect of ICL in patients with myopia.

Methods • A Retrospective Study Spanning from 2021 to 2023 within Huai'an First People's Hospital. This study involves the comparative analysis of 100 eyes subjected to 'Crystalline Lens Extraction + IOL' and 100 eyes undergoing 'ICL' treatment. We evaluate various postoperative parameters, including near and distant visual acuity, Visual Acuity (CVA), Best-Corrected Visual Acuity (BCVA), refractive outcomes, endothelial cell count, glare sensitivity, and the incidence of macular edema. The control group underwent Crystalline Lens Extraction + IOL, and the observation group underwent 'ICL' treatment. Visual acuity recovery, intraocular pressure, endothelial cell count, adverse reactions, and therapeutic effect were compared between the two groups.

Results • The CVA before treatment and the IOP and endothelial cell count before and after treatment in the observation group were similar to those in the control group, and the differences were not statistically significant ($P > .05$). The CVA, BCVA, and refraction after treatment in the observation group were all higher than those in the control group, and the differences were statistically significant ($P < .05$). The number of people with significant and effective treatment effects in the observation group (total effective rate 98.00%) was higher than that in the control group (82.00%), and the difference was statistically significant ($P < .05$).

Conclusions • The implantation of 'ICL' treatment in cases of myopia demonstrates favorable surgical outcomes in clinical practice. It effectively enhances postoperative visual function recovery while minimizing the risk of adverse reactions. The ICL implantation procedure is irreplaceable in the treatment of myopia. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Myopia primarily causes blurred vision due to parallel light rays focusing in front of the retina. Common symptoms include visual fatigue and exotropia, with potential ocular changes.[1] Untreated, it may severely impair vision and lead to blindness. In clinical practice, the main treatments are prescription glasses, medication, and surgery. However, glasses and medication are often less effective in reducing myopia. Surgical options, like refractive corneal surgery and Intraocular Lens (IOL) implantation, can effectively correct the focus of light rays, helping patients regain better vision.[2]

Advancements in medical technology have led to various surgical procedures, such as clear lens extraction combined with IOL implantation and posterior chamber ICL implantation in eyes with natural lenses. Posterior chamber ICL implantation is notable for preserving corneal integrity, aiding in postoperative vision recovery. However, studies on its use in myopia are limited.[3] This study compares the effects of posterior chamber ICL implantation on postoperative visual acuity and intraocular pressure in myopic patients.

While ICL surgery is effective, it is costly and may require additional surgeries in old age, such as lens removal, IOL implantation, and removal of the initial ICL. This increases surgical frequency and patient burden. Consequently, some experts and patients suggest replacing the ICL procedure with a combination of 'crystal extraction + IOL.' This retrospective study explores the feasibility of this alternative approach.[4]

PATIENTS AND METHODS

Patients

In this retrospective study conducted from January 2021 to August 2023 at Huai'an First People's Hospital, 100 myopic

patients were selected and divided into a control group (82 patients, 100 eyes) and an observation group (50 patients, 100 eyes). The average age was 32.52±4.06 years, with a disease duration of 3-15 years and an average of 9.03±1.65 years. Axial length ranged from 24.69 to 32.71 mm, with a mean of 28.72±1.85 mm. The observation group included 24 males and 26 females, aged 20-43 years (mean age 32.06±3.96 years), disease duration of 3-16 years (mean 9.53±1.86 years), and axial lengths between 24.71 and 32.76 mm (mean 28.75±1.95 mm). At baseline, there was no statistically significant difference between the two groups in terms of gender composition, age, duration of disease, or operated eyes ($P > .05$).

The experimental protocol was meticulously designed to comply with the ethical standards outlined in the Declaration of Helsinki. This included obtaining informed consent from all participants after fully explaining the study's purpose, procedures, potential risks, and benefits. An independent ethics committee provided oversight and approval for the study, ensuring a favorable risk-benefit ratio and the protection of participant rights and welfare. Additionally, stringent measures were implemented to safeguard participant privacy and confidentiality, maintaining the integrity and ethical conduct of the research. Patients all met the diagnostic criteria for myopia in the Expert Consensus on Emphasis on Prevention and Control of High Myopia;[5] naked eye visual acuity < .5, and myopia was confirmed by dilated pupil examination, fundus examination and slit lamp examination. Inclusion criteria were as follows: (i) patients were aged 20-45 years; (ii) patients had typical medical conditions such as visual fatigue and blurred vision; (iii) patients had stable refractive status and thin corneas within 1 year; (iv) patients had complete basic information; Exclusion criteria were as follows: i) the patient had other ocular diseases such as pigment dispersal syndrome; ii) the patient had underlying diseases such as uncontrollable diabetes and hypertension; iii) the patient had contraindications to surgery; iv) the patient had a history of ophthalmic surgery; v) the patient had mental impairment, language impairment, cognitive impairment.

Methods

Patients in both groups received comprehensive refraction, intraocular pressure, mydriatic examination, and conventional slit lamp examination.

Patients in the control group were treated as follows: Crystalline Lens Extraction + IOL was performed on the patient. IOL is employed for younger patients with early-stage cataracts. The patient was placed in the supine position, and the patient was given surface anaesthesia. Once the patient was under anaesthesia, an incision was made 1mm inside the corneal limbus (3mm, clear corneal tunnel). A secondary incision was made at 3 o'clock on the corneal limbus, a viscoelastic was injected into the anterior chamber, the capsule was torn continuously, and after the emulsification energy had decreased, the lens nucleus was aspirated and polished. An imported Premium Intraocular Lens was implanted in the capsule. After surgery, routine anti-infective and antibacterial medication was given.

The patients in the observation group took the following measures: the patients in the observation group underwent implantable contact lens. The patient was placed in a supine position and under local anesthesia. After the patient entered the anesthesia state, we placed the intraocular lens in the special syringe with its front side facing upwards (operating under the microscope); we curled and folded it backward, placed the injection tube in the injector, and immersed it in the balanced salt solution for later use. An incision (about 3 mm, transparent corneal tunnel and auxiliary incision) was also made at 1 mm and 3 o'clock in the limbus, after which the front end of the injector was placed at the incision site, the intraocular lens was slowly pushed into the iris plane, viscoelastic was injected on the intraocular lens (in the anterior chamber), the intraocular lens was adjusted through the auxiliary incision to ensure that the four loops of the intraocular lens were in the posterior iris and anterior ciliary sulcus of the lens, the viscoelastic was washed, and the incision was closed watertight. At the end of surgery, conventional anti-infective and antibacterial drugs were given.

Observed indicators

The study compared visual acuity recovery between two groups, assessing conventional visual acuity (CVA), best corrected visual acuity (BCVA), and refraction before and one month after treatment. Additionally, intraocular pressure and endothelial cell counts (measured using an SP-3000P corneal endothelial cell counter from TOPCON, Japan) were evaluated before and one-month post-surgery. The therapeutic effect was assessed from immediate post-operation to a six-month follow-up. The criteria for evaluating therapeutic effects were as follows: 'Significant' for CVA ≥ 0.85 and BCVA ≥ 0.95, with no retinal detachment or adverse reactions, exceeding expected visual recovery within the timeframe; 'Effective' for CVA between 0.75 and 0.85, BCVA between 0.85 and 0.95, or mild retinal detachment without overall efficacy impact, achieving expected visual recovery within the timeframe; and 'Ineffective' for CVA < 0.75, BCVA < 0.85, or severe retinal detachment adversely affecting overall efficacy, not meeting the expected visual recovery within the timeframe. The overall response rate is calculated as the sum of significant and effective rates.

Statistical analysis

Statistical Product and Service Solutions (SPSS) 23.0 (IBM, Armonk, NY, USA) was applied for statistical analysis. Independent sample t-test was used for comparison between groups for measurement data obeying normal distribution, and independent sample t test was used for comparison within groups, all expressed as ($\bar{x} \pm s$). Count data were tested by χ^2 and expressed as a rate (%); $P < .05$ indicates a statistical difference.

RESULTS

Visual acuity recovery between the two groups

The CVA of the observation group before treatment was similar to those of the control group, and the differences were not statistically significant ($P > .05$). The BCVA was poor in the control group. ($P < .05$) The CVA, BCVA, and refraction in the observation group were higher than those in the control group after treatment, and the differences were statistically significant ($P < .05$) (Table 1).

Intraocular pressure and endothelial cell count between the two groups.

The intraocular pressure and endothelial cell count before and after treatment in the observation group were similar to those in the control group, and the differences were not statistically significant ($P > .05$) (Table 2).

The treatment effect of the two groups

The number of patients with significant and effective treatment effects (overall response rate 98.00%) in the observation group was more (higher) than that in the control group (82.00%), and the difference had statistical significance ($P < .05$) (Table 3).

Table 1. Compares the visual acuity recovery between the two groups ($\bar{x} \pm s$)

Group	n	CVA		BCVA		Diopter (D)	
		Before treatment	Post Treatment	Before treatment	Post Treatment	Before treatment	Post Treatment
Observation group	100	0.08 ± 0.02	0.88 ± 0.13[a,b]	0.84 ± 0.23	0.99 ± 0.29[a,b]	- 12.21 ± 3.12	- 0.74 ± 0.25[a,b]
Control group	100	0.09 ± 0.03	0.76 ± 0.09[a]	0.72 ± 0.25[b]	0.87 ± 0.26	- 12.17 ± 3.09	- 0.88 ± 0.21[a]
t	-	1.961	5.367	3.532	2.179	0.064	3.032
P value	-	.053	.001	.0005	.032	.949	.003

[a]Compared to pre-treatment, $P < .05$
[b]Compared to control group, $P < .05$.

Table 2. Compares intraocular pressure and endothelial cell count between the two groups ($\bar{x} \pm s$)

Group	n	Intraocular pressure (mmHg)		Endothelial cell count (cells/mm^2)	
		Before treatment	Post Treatment	Before treatment	Post Treatment
Observation group	100	14.32 ± 1.53	13.96 ± 1.15	3206.21 ± 221.58	3174.75 ± 223.81
Control group	100	14.83 ± 1.78	13.94 ± 1.05	3199.89 ± 219.43	3187.74 ± 221.85
t	-	1.536	0.091	0.143	0.292
P value	-	.128	.928	.886	.771

Table 3. Comparison of treatment effect between the two groups [n, (%)]

Group	n	Significant	Effective	Invalid	Overall response rate
Observation group	100	24 (48.00%)	25 (50.00%)	1 (2.00%)	49 (98.00%)
Control group	100	14 (28.00%)	27 (54.00%)	9 (18.00%)	41 (82.00%)
χ^2	-	4.245	0.161	5.444	5.444
P value	-	.039	.689	.020	

DISCUSSION

Myopia is a type of refractive error and is the most common eye disease. Epidemiology shows that the prevalence of myopia in China is 33%, with a significant increase in prevalence as the year progresses.[6] Although the causes of myopia formation are not yet clear. Relevant studies have shown that genetics, poor eye use, and poor environmental lighting are common high-risk factors for myopia.[7] Also, micronutrient deficiency and prolonged close viewing of electronic screens are common predisposing factors for myopia.[8] As myopia increases, symptoms such as blurred vision increase, and whether it is a blurred vision or thick glasses, it will bring a lot of inconvenience to life and greatly reduce the quality of life.

Therefore, in order to improve the treatment effect of myopia, this study proposes to apply posterior chamber ICL implantation in the lens-bearing eye to the clinical treatment of this condition. In this study, (1) CVA, BCVA, and refraction were higher in the observation group than in the control group after treatment ($P < .05$), suggesting that this surgical treatment method can achieve better visual recovery results. The reasons for this may be as follows: myopia was mainly caused by the focusing of parallel light in front of the retina when the eye was relaxed under regulation, and the treatment mechanism of myopia surgery was mainly to improve visual acuity and cure myopia by adjusting the focusing position of parallel light into the eye.[9] In the control group, crystal extraction + IOL was used, although it generally achieved a better myopia cure. However, the removal process would aggravate the degree of damage to the eye tissue and increase the risk of retinal detachment.[10] With the advancement of modern medical technology, posterior chamber ICL implantation in the lens-bearing eye can preserve the integrity of the cornea by implanting an ICL with a certain degree of refractive power into the posterior chamber, effectively preserving the natural adjustment function of the patient's own lens, which is important for the restoration of postoperative visual acuity.[11] At the same time, with modern technology, the contact area between the posterior chamber ICL and the anterior surface of the lens is constantly reduced, which further reduces lens damage and facilitates the recovery of visual function after surgery. Thus, compared with the control group, the post-operative recovery of visual acuity was better in the observation group. (2) The IOP and endothelial cell counts in the observation group before and after treatment were similar to those in the control group ($P > .05$). This may be due to the fact that, with modern medical technology, posterior chamber ICLs have the potential to strengthen the physiological barrier of the posterior capsule, reduce the degree of vitreous base traction, and reduce the risk of postoperative retinal detachment.[12] 2. The high arch between the posterior chamber ICL and the natural lens facilitates the natural flow of atrial fluid between the ICL and the natural lens after ICL implantation, which has a positive impact on reducing the stress caused by ICL implantation, maintaining a more stable IOP and endothelial cell count, and reducing the risk of adverse effects such as glaucoma. (3) The number of significant and effective treatment results (total effective rate) was higher in the observation group than in the control group ($P < .05$), suggesting that posterior chamber ICL implantation in eyes

with a lens can achieve better surgical outcomes. The main reason for this is that compared to crystal extraction + IOL, this surgical treatment is less invasive to the normal tissues of the eye, and with modern materials and medical technology, the contact surface between the ICL and the natural lens is smaller, which facilitates the recovery of the natural lens adjustment function after surgery and helps patients to maintain a better and more stable visual function recovery, which is important for improving postoperative visual acuity.[13] The overall efficiency of the patients in the observation group was thus higher. Wang et al.[15] showed that patients with high myopia who underwent posterior chamber ICL implantation with a lens had higher postoperative CVA, BCVA, refraction, and better visual acuity recovery, which is consistent with the results of this study. Li et al.[15] showed that myopic patients who underwent posterior chamber ICL implantation with a lens had higher postoperative BCVA, and there were no significant differences in IOP and endothelial cell counts before and after surgery, and the surgery was safer, which is consistent with the results of this study. This suggests that posterior chamber ICL implantation in lens-bearing eyes is convenient, safe, and reliable and facilitates postoperative vision recovery. There are limitations to this study, such as the small sample size in this study and the young age of the population covered in the article does not allow for further assessment of the older population, so further validation with a randomized, double-blind, multicenter, large sample size of patients is needed.

This study has certain limitations that should be acknowledged. Firstly, the sample size of 100 myopic patients, while significant, is relatively small and may not fully represent the broader population with myopia. Additionally, the age range of the patients (20-45 years) limits the generalizability of the findings to older populations who may experience different outcomes or complications. The retrospective nature of the study also poses limitations, as it relies on existing data and may not capture all relevant variables. Furthermore, the study was conducted at a single center, which could influence the results due to specific regional or institutional practices. Future research with a larger, more diverse sample size and a prospective design, possibly across multiple centers, would provide more comprehensive insights into the effectiveness and safety of the surgical treatments for myopia discussed in this study.

CONCLUSIONS

The ICL implantation for the treatment of myopia has demonstrated favorable surgical outcomes in clinical practice. This procedure effectively enhances postoperative visual function recovery while minimizing the risk of adverse reactions. The ICL implantation procedure is irreplaceable in the treatment of myopia.

CONFLICT OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

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AUTHOR CONTRIBUTIONS

QP and CL designed the study and performed the experiments, SZ collected the data, HC analyzed the data, QP and CL prepared the manuscript. All authors read and approved the final manuscript.

ETHICAL COMPLIANCE

This study was approved by the Ethics Committee of the First People's Hospital of Huai'an City under the ethical approval number: KY-2023-202-01.

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