

First Results of Observation of Patients with Complex Refractive Anomalies After Correction Using Phakic Intraocular Lenses

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Abstract

Today, the frequency of complex refractive errors among people of active age is one of the main problems of our time. Phakic intraocular lens implantation is one of the most modern surgical methods for correcting of complex types of refractive errors. High myopia and compound myopic astigmatism are among the leading causes of reduced visual function in working-age adults. Spectacles, contact lenses and corneal laser surgery are often insufficient or contraindicated. Posterior-chamber phakic intraocular lenses (ICL) offer an alternative that preserves the cornea and the natural crystalline lens. To assess the early clinical results of collamer ICL implantation (VICM5 / VTICM5) in patients with high myopia and compound myopic astigmatism.

Keywords: Complex refractive error, myopia, phakic intraocular lens, implantation.

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1. Introduction

Refractive errors remain the leading pathology of the visual organ among the working-age population. According to the World Health Organization, they affect 23–40% of people worldwide. High myopia and compound myopic astigmatism occupy a special place among these disorders: they not only reduce uncorrected and best-corrected visual acuity, but may also lead to irreversible structural changes of the eye and to a substantial loss of visual function.

Spectacle correction of high ametropia is limited by aniseikonia, prismatic imbalance and poor optical quality. Contact lenses are often poorly tolerated. Corneal laser procedures (LASIK, SMILE, PRK) are contraindicated when residual stromal thickness is insufficient, topography is abnormal, dry-eye syndrome

is clinically significant, or the refractive error exceeds the safe range of photoablation. In such patients an alternative is required that preserves the cornea and the natural crystalline lens.

Phakic intraocular lenses (PIOLs), particularly posterior-chamber collamer lenses (ICL; models such as VICM5 and VTICM5), meet this need. They correct a wide range of myopia and myopic astigmatism, produce a retinal image close to physiological size, and have demonstrated high efficacy and safety indices in published series. Early postoperative monitoring is essential: residual spherical equivalent, intraocular pressure, endothelial cell density and the vault between the implant and the crystalline lens determine both optical quality and long-term safety.

The aim of this study was to evaluate the early clinical outcomes after posterior-chamber phakic IOL

implantation in patients with high myopia and compound myopic astigmatism.

Relevance of the problem. At present, refractive errors are the leading pathology of the visual organ among the working-age population [1,2]. According to the World Health Organization, the proportion of patients with refractive errors worldwide ranges from 23% to 40% [3,4,5]. Progression of refractive errors may lead to serious irreversible changes of the visual organ and even to a substantial loss of visual function [6,8]. Taking the above into account, one of our main objectives was to evaluate the early clinical results after application of a modern method of correction in high myopia and compound myopic astigmatism.

Aim of the study. To evaluate the early clinical outcomes after phakic intraocular lens implantation in patients with high myopia and compound myopic astigmatism.

2. Methods

The study was based on the analysis of clinical outcomes after phakic intraocular lens implantation in a total of 12 patients (22 eyes) with a diagnosis of high myopia and compound myopic astigmatism who were under dynamic observation at the private eye clinic “NAZAR EYE CLINIC” from January 2024 to May 2024. The sex distribution of the patients was as follows: 9 women (75%) and 3 men (25%). The age of the observed patients ranged from 20 to 32 years, with a mean age of 24.1 ± 3.4 years. A collamer-based posterior-chamber phakic intraocular lens of ICL type (models VICM5 and VTICM5) was implanted in 22 eyes of 12 patients with high myopia and compound myopic astigmatism. In the studied patients, the mean manifest spherical equivalent was -8.35 ± 4.23 D, the mean manifest cylinder was -2.55 ± 1.2 D, and Snellen visual acuity was UCVA 0.04 $\pm$ 0.02 and BCVA 0.25 $\pm$ 0.13. The horizontal white-to-white (W–W) diameter was 11.68 ± 0.35 mm, the mean anterior chamber depth was 2.95 ± 0.14 mm, and keratometric values were K1: 43.35 ± 1.75 D and K2: 43.75 ± 1.54 D. Mean axial length was 26.25 ± 1.64 mm, central corneal thickness was 489.2 ± 27.5 μ m, and IOP was 14.5 ± 1.36 mmHg. Endothelial cell density was 2978 ± 85 cells/mm².

Patients with complex refractive errors were selected for posterior-chamber phakic IOL implantation in accordance with the recommended criteria. The following were taken into account: patient age of 20

years or older; anterior chamber depth (distance from the corneal endothelium to the anterior capsule of the crystalline lens) greater than 2.8 mm; preservation of the natural crystalline lens; and stability of the refractive error over the preceding year. No contraindications to surgery were identified among the patients recommended for posterior-chamber phakic IOL implantation. In accordance with the Declaration of Helsinki, the patient and a close relative were fully informed about the procedure, and written consent for the planned surgery was obtained.

Comprehensive examination of the patients included general and special ophthalmological methods. Special investigations were performed with the following devices. Refractive and keratometric parameters were measured with the autokeratorefractometer “KR-1 Autokeratorefractometer” (Topcon, Japan). Echo-biometric data were obtained with the A/B-scan ultrasound device “A/B scan UD-800” (Tomey, Japan). Intraocular pressure and central corneal thickness were measured with the “CT-1P non-contact tonopachymeter” (Topcon, Japan). Corneal thickness, horizontal W–W diameter and keratopographic data were assessed using “Keratotopography, Pentacam” (Oculus, Germany) and “Orbscan III, ZYWAVE3” (Bausch and Lomb, USA; Technolas, Germany). Endothelial cell density was determined with the “specular microscope SP-P1” (Topcon, Japan). Endothelial cell counts were studied before surgery and at postoperative follow-up visits in eyes scheduled for phakic IOL implantation. After implantation of the phakic intraocular lens, anterior-segment optical coherence tomography with “DRI OCT Triton” (Topcon, Japan) was used to measure the space between the anterior surface of the crystalline lens and the implant (vault). All obtained data were processed statistically using descriptive statistics in Microsoft Office Excel 2016.

These early results confirm that posterior-chamber collamer ICL implantation is an effective option for high myopia and compound myopic astigmatism when corneal laser surgery is contraindicated. In a young adult cohort with mean SE of -8.35 D, thin corneas (mean CCT 489.2 μ m) and reduced preoperative BCVA (0.25), optical rehabilitation was rapid: BCVA rose to 0.70 at 1 month, with safety and efficacy indices of 1.34 and 1.28. Predictability was high: 95% of eyes were within ± 0.50 D of intended SE.

The findings agree with larger ICL series in which most

eyes reach a residual SE close to emmetropia, safety indices exceed 1.0, and endothelial cell loss in the first weeks to months remains limited. Mean vault values in the present study (approximately 380–420 μm) lie within the range generally regarded as acceptable for current ICL models, reducing the risk of both cataract (low vault) and angle crowding (excessively high vault). IOP showed a slight early rise and then declined toward baseline, which is a known transient phenomenon after ICL implantation and requires routine monitoring.

The principal limitations are the small sample (12 patients, 22 eyes) and the short follow-up (1 month). These constraints do not allow conclusions about late endothelial stability, cataract formation, vault decay or refractive regression. A larger cohort and longer observation are therefore planned.

3. Results

After planned phakic IOL implantation in 22 eyes of 12 patients with high myopia and compound myopic astigmatism at “NAZAR EYE CLINIC”, Snellen BCVA at 1 day, 1 week and 1 month was 0.65 ± 0.22 , 0.68 ± 0.2 and 0.70 ± 0.16 , respectively. A statistically significant change was found between preoperative and 1-month postoperative UCVA and BCVA (paired Student's t-test, $p < 0.001$). The safety index was 1.34 and the efficacy index was 1.28. At 1 day, 1 week and 1 month after surgery, residual manifest spherical equivalent (SE) was within ± 0.50 D of the planned SE in 95% of eyes. Preoperative manifest SE of -8.35 ± 4.23 D decreased postoperatively to a mean of within ± 0.50 D (paired Student's t-test, $p < 0.001$).

Determination of IOP is one of the principal monitoring parameters after PIOL implantation. In this study, pre- and postoperative IOP values were analyzed. IOP at 1 day, 1 week and 1 month after surgery was 15.64 ± 2.15 , 15.13 ± 1.7 and 14.56 ± 1.5 mmHg, respectively; mean postoperative IOP was 15.11 ± 1.8 mmHg.

Endothelial cell density was 2978 ± 85 cells/ mm^2 before surgery, 2945 ± 63 cells/ mm^2 at 1 week and 2936 ± 54 cells/ mm^2 at 1 month after surgery.

The vault between the phakic intraocular lens and the anterior surface of the natural crystalline lens was 421.3 ± 45.7 μm on postoperative day 1, 395.2 ± 38.4 μm at 1 week and 382.6 ± 41.2 μm at 1 month.

4. Conclusion

Correction of complex refractive errors with phakic intraocular lenses is a modern method. It is an alternative surgical solution in patients with contraindications to LASIK, such as insufficient corneal thickness, dry-eye syndrome and a high degree of refractive error. In this study, conducted in a small group of patients with high myopia and compound myopic astigmatism at an eye clinic, the aims that we had set were achieved. However, the limited amount of material and the short follow-up period do not allow a complete analysis of the postoperative results. We have included in our plans the continuation of this research on a larger scale and with longer-term follow-up.

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