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Original Article

Sirius Cutting Mode enhances vision and reduces myopia severity through personalized treatment

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Abstract: Objective: To assess the reliability of vision correction for presbyopia using the Sirius Cutting Mode and its effect on visual acuity, corneal mechanics, and high-order aberrations over time. Methods: This retrospective study analyzed data from 150 presbyopic patients. Of these, 74 received personalized vision correction using the Sirius Cutting Mode, while 76 served as controls with no presbyopia treatment. Participants were selected from a predefined database based on strict inclusion and exclusion criteria. Data on spherical equivalent, visual acuity, stereo testing, eye mechanics, and high-order aberrations were collected at baseline and at the end of the follow-up period. Multivariate regression analysis was conducted to identify factors influencing near visual acuity outcome. Results: The treatment group demonstrated significant improvements in uncorrected distance visual acuity (UDVA) and near visual acuity (NVA) at all follow-up intervals compared to the control group (both $P < 0.001$). Additionally, the treatment group showed a significant reduction in myopia, with lower spherical equivalent values at 10 days, 1 month, 3 months, and 6 months (all $P < 0.001$). High-order aberrations were significantly reduced, and corneal biomechanical properties, including maximum deformation amplitude and maximum deformation curvature radius, and improved at 6 months (all $P < 0.001$). Multivariate analysis identified the Sirius Cutting Mode as a significant predictor of NVA outcomes ($P < 0.001$). Conclusion: The Sirius Cutting Mode with personalized treatment results in improved vision for both near and far distances, reduced myopia severity, and decreased higher-order aberrations in presbyopic patients.

Keywords: Presbyopia, personalized vision correction, Sirius Cutting Mode, visual improvement, refractive surgery

Introduction

Presbyopia typically develops gradually from the age of 40 and worsens over time [1]. The loss of elasticity in the lens and ciliary muscle makes it increasingly difficult to focus on nearby objects [2]. As global populations age, presbyopia has become widespread, particularly among those over 40 [3, 4]. Current treatments, such as reading glasses, bifocals, and multifocal contact lenses, offer partial relief but fail to address the underlying issue [5-8]. Presbyopic LASIK and corneal inlays show some promise but are still associated with safety concerns, limited effectiveness, and patient dissatisfaction, especially for those with complex visual needs [8-10].

Recent advances in refractive surgery now allow for personalized vision correction strategies tailored to patients with presbyopia. The Sirius Cutting Mode, for example, utilizes the latest corneal data and wavefront-based planning to create a surgical approach customized to each patient's vision requirements [11]. By precisely mapping the corneal surface, Sirius Mapping enables more effective and personalized treatment, improving visibility at all distances [12]. While there is strong evidence supporting the efficacy of personalized methods for presbyopia, long-term studies remain scarce. This study aims to assess the long-term impact of the Sirius Cutting Mode in providing customized treatment for presbyopic patients.

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This work presents the results of using the Sirius Cutting Mode for personalized vision correction in presbyopic patients, addressing both near and distance vision challenges. Our research contributes to existing efforts to integrate personalized refractive procedures into clinical practice. We hope that this study will provide valuable insight into improving the management and customization of vision correction for presbyopia.

Materials and methods

Case selection

Between September 2024 and March 2025, 150 presbyopic patients from the Ophthalmology department of Lishui People's Hospital were included in this study. Participants were assigned to either the treatment group (n = 74), which received personalized vision correction using the Sirius Cutting Mode, or the control group (n = 76), which did not undergo any presbyopia treatment.

Patients were selected based on specific criteria to ensure reliable and accurate results. Eligible participants had: (1) a confirmed diagnosis of presbyopia [13], (2) were aged 40-65 years, (3) tolerated the procedure, (4) no significant ocular diseases other than presbyopia, (5) good overall health, and (6) the ability to attend follow-up visits. Exclusion criteria included: (1) significant ocular conditions, (2) recent eye surgery or trauma, (3) severe refractive errors other than presbyopia, (4) uncontrolled systemic diseases, (5) pregnancy or breastfeeding, and (6) incomplete records. The study adhered to ethical standards outlined in the Declaration of Helsinki and was approved by the ethics committee of Lishui People's Hospital.

Data collection

The treatment group underwent individualized vision correction using the Sirius Cutting Mode, a topography-guided, customized procedure. A corneal topography test using the Sirius system first assessed each patient's unique corneal shape, thickness, and curvature. Based on these findings, a tailored treatment plan was developed to improve both near and far vision. Anesthetic was applied, followed by the creation of a corneal flap using a femtosecond laser, and reshaping the cornea with an excimer laser to correct corneal irregularities and enhance vision.

The control group did not receive any treatment for presbyopia but was monitored over time to track changes in their vision. Data were collected at baseline and at follow-up points: 10 days, 1 month, 3 months, and 6 months. Key measurements included uncorrected and near visual acuity, spherical equivalent refraction, and high-order aberrations. Corneal stability was assessed by measuring maximum deformation amplitude (MDA) and maximum deformation curvature radius (MDR) at the 6-month follow-up. Stereopsis was assessed at every visit. The same protocols were followed for both groups to ensure data accuracy and consistency.

Outcome measurement

The primary outcomes were changes in uncorrected distance visual acuity (UDVA) and near visual acuity (NVA) over the 6-month follow-up period. UDVA was measured at baseline and at the following intervals: 10 days, 1 month, 3 months, and 6 months. NVA was assessed at each follow-up visit. Refractive outcomes were evaluated by comparing the spherical equivalent (SE) between the treatment and control groups at all time points. High-order aberrations (HOAs), including horizontal coma, vertical coma, and spherical aberration, were measured using a wavefront aberrometer at baseline and each follow-up visit. Depth perception was tested at each interval. Corneal morphologic indicators, including MDA and MDR, were evaluated using the Sirius topographer before the intervention and at the 6-month follow-up to assess corneal stability. Multivariate regression analysis was performed to identify factors influencing NVA outcome. All measurements were conducted by trained personnel following standardized protocols to ensure accuracy.

Statistical methods

All statistical analyses were performed using SPSS version 25.0 (IBM Corp). Descriptive statistics were used to summarize patient demographics and ocular health parameters. Normality of the data was assessed using the

Table 1. Comparison of baseline characteristics

Characteristic	Treatment Group (n = 74)	Control Group (n = 76)	*P*-value
Age	38.85 ± 9.43	40.43 ± 10.63	0.337
Gender			0.729
Male (%)	32 (43.2%)	35 (46.1%)	
Female (%)	42 (56.8%)	41 (53.9%)	
Spherical Equivalent	-4.47 ± 1.97	-4.28 ± 1.92	0.537
Astigmatism	-1.00 ± 0.41	-0.96 ± 0.42	0.512
Hypertension (%)	18 (24.3%)	20 (26.3%)	0.779
Diabetes (%)	12 (16.2%)	11 (14.5%)	0.767
Hyperlipidemia (%)	8 (10.8%)	9 (11.8%)	0.842
Dry Eye Symptoms (%)	3 (4.1%)	4 (5.3%)	0.726
Prescription for presbyopia	1.41 ± 0.48	1.42 ± 0.53	0.903

Shapiro-Wilk test. Continuous variables were presented as means ± standard deviations (SD) for normally distributed data or as medians with interquartile ranges (IQR) for non-normally distributed data. Between-group comparisons for continuous variables were made using independent t-tests for normally distributed data or Mann-Whitney U tests for non-normally distributed data. Categorical variables were expressed as frequencies and percentages, with differences assessed using the Chi-square test or Fisher's exact test, as appropriate. To compare baseline and follow-up values (10 days, 1 month, 3 months, and 6 months), repeated measures analysis of variance (ANOVA) followed by Tukey's HSD test was conducted. Multivariate logistic regression was used to identify factors influencing improvements in NVA, adjusting for potential confounders. A *p*-value of < 0.05 was considered significant.

Results

Comparison of baseline characteristics

The baseline characteristics of the two groups were comparable, with no significant differences in age, gender, uncorrected and near visual acuity, spherical equivalent, astigmatism, or systemic conditions (all P > 0.05, **Table 1**). These results confirm that the groups were well-matched, ensuring a reliable comparison of treatment outcomes and attributing any observed differences to the intervention.

Comparison of changes in vision and refractive conditions

At 10 days post-intervention, the treatment group demonstrated significantly better UDVA compared to the control group (P = 0.003), and this advantage persisted at 1 month, 3 months, and 6 months (all P < 0.001) (**Figure 1A**). A similar trend was observed for NVA. Although baseline NVA levels were comparable between groups (P > 0.05), the treatment group achieved significantly better NVA at all post-intervention time points-10 days, 1 month, 3 months, and 6 months (all P < 0.001) (**Figure 1B**). These results indicate that personalized vision correction with the Sirius Cutting Mode provides sustained improvements in both near and distance vision over the follow-up period.

Comparison of spherical equivalent

The SE values significantly differed between the treatment and control groups at all time points (**Table 2**). At 10 days post-intervention, the treatment group had a significantly lower SE (-0.40 ± 0.57) compared to the control group (-1.13 ± 0.66, P < 0.001). This difference persisted at 1 month, 3 months, and 6 months, with the treatment group consistently showing lower SE values (all P < 0.001). The treatment significantly reduced myopia at each stage, with highly significant differences between the groups.

Comparison of high-order aberrations

At 10 days postoperatively, the treatment group showed significant reductions in total HOAs, including horizontal coma, vertical coma, and spherical aberration, compared to the control group (all P < 0.001). This trend continued at 1, 3, and 6 months, with the treatment group showing significantly lower aberrations at each time point (all P < 0.001, **Table 3**).

Comparison of stereopsis

At all follow-up intervals (10 days, 1 month, 3 months, and 6 months), both the treatment and control groups showed similar stereopsis outcomes. The *p*-values for all comparisons were consistently above the threshold for statistical significance (P > 0.05, **Table 4**), indicating no clinically relevant differences between

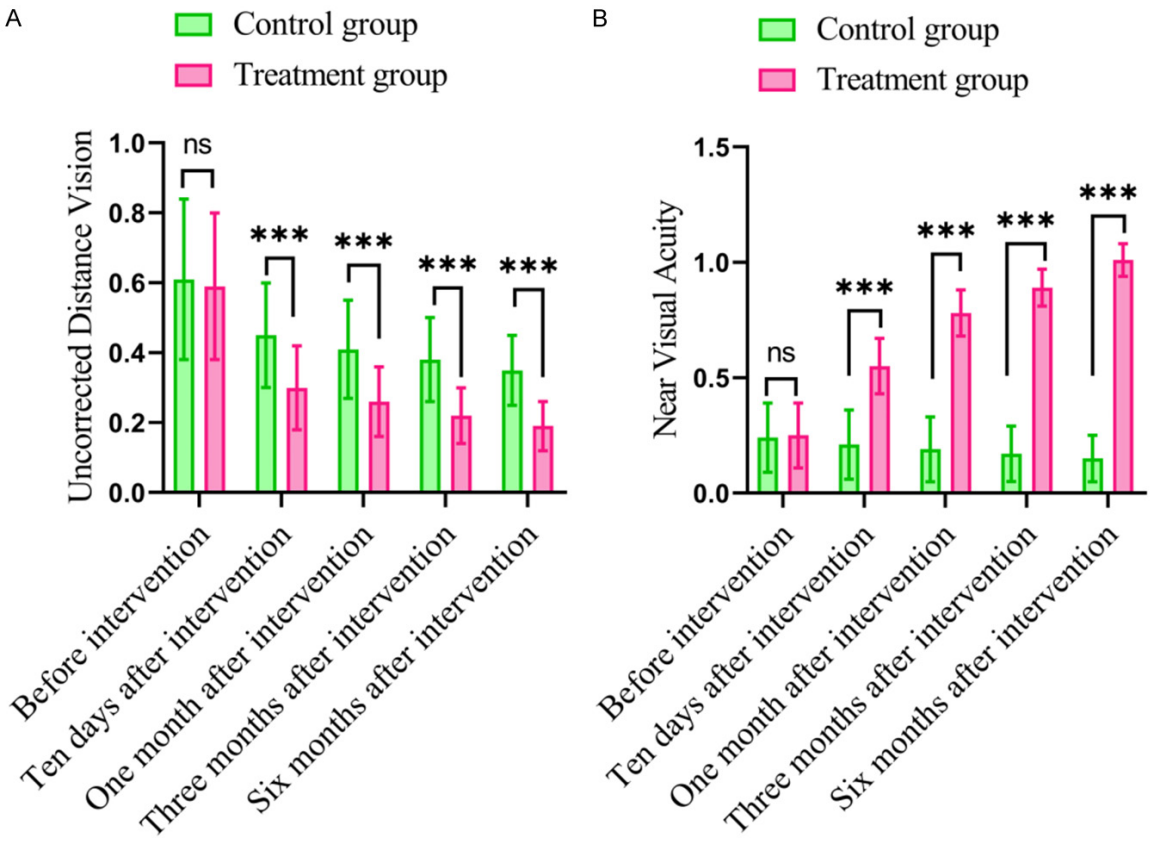

Figure 1. Comparison of the changes in vision and refractive conditions between the two groups. A. Uncorrected Distance Vision, B. Near Visual Acuity. ***P < 0.001, compared to the control group.

Table 2. Comparison of spherical equivalent between the two groups

Time Point	Treatment Group (n = 74)	Control Group (n = 76)	F	*P*-value	Post-hoc Test
10 Days after intervention	-0.40 ± 0.57	-1.13 ± 0.66	51.496	0.000	0.000
1 Month after intervention	-0.44 ± 0.44	-1.10 ± 0.53	67.876	0.000	0.000
3 Months after intervention	-0.35 ± 0.29	-1.07 ± 0.42	148.732	0.000	0.000
6 Months after intervention	-0.50 ± 0.47	-1.10 ± 0.06	125.024	0.000	0.000

the groups. These results suggest that stereopsis was comparable in both groups throughout the study.

Comparison of corneal biomechanical indicators

Both groups exhibited similar IOP values before and after the intervention, with no statistically significant differences (P > 0.05). However, the treatment group showed a significant increase in MDA and MDR at the 6-month follow-up compared to the control group (P < 0.001) (**Figure 2**).

Comparison of visual outcomes

The treatment group consistently outperformed the control group at each follow-up time point, with significant differences observed at all intervals (all P < 0.001, **Figure 3**).

Multivariate regression analysis of factors influencing near visual acuity

Multivariate logistic regression identified the use of the Sirius Cutting Mode as a significant independent factor influencing near visual acuity (OR: 4.527, 95% CI: 2.505-8.182, P < 0.001)

Table 3. Comparison of High-order aberrations (HOAs) between the two groups

	Time Point	Treatment Group (n = 74)	Control Group (n = 76)	F	*P*-value	Post-hoc Test
Total HOAs	Preoperative	0.39 ± 0.15	0.43 ± 0.16	2.644	0.106	0.587
	10 Days after intervention	0.31 ± 0.10	0.45 ± 0.15	44.239	0.000	0.000
	1 Month after intervention	0.28 ± 0.08	0.49 ± 0.14	120.181	0.000	0.000
	3 Months after intervention	0.25 ± 0.08	0.45 ± 0.12	130.520	0.000	0.000
	6 Months after intervention	0.22 ± 0.07	0.42 ± 0.12	174.696	0.000	0.000
Horizontal Coma	Preoperative	0.19 ± 0.04	0.18 ± 0.06	0.440	0.459	0.459
	10 Days after intervention	0.10 ± 0.03	0.18 ± 0.06	115.755	0.000	0.000
	1 Month after intervention	0.09 ± 0.01	0.17 ± 0.06	137.994	0.000	0.000
	3 Months after intervention	0.08 ± 0.02	0.16 ± 0.05	172.857	0.000	0.000
	6 Months after intervention	0.07 ± 0.02	0.16 ± 0.04	263.535	0.000	0.000
Vertical Coma	Preoperative	0.14 ± 0.05	0.15 ± 0.06	2.805	0.096	0.096
	10 Days after intervention	0.09 ± 0.03	0.15 ± 0.05	59.978	0.000	0.000
	1 Month after intervention	0.08 ± 0.02	0.15 ± 0.04	210.081	0.000	0.000
	3 Months after intervention	0.08 ± 0.02	0.14 ± 0.04	113.131	0.000	0.000
	6 Months after intervention	0.06 ± 0.02	0.13 ± 0.04	204.708	0.000	0.000
Spherical Aberration	Preoperative	0.11 ± 0.03	0.11 ± 0.03	0.511	0.476	0.476
	10 Days after intervention	0.07 ± 0.02	0.15 ± 0.04	217.662	0.000	0.000
	1 Month after intervention	0.06 ± 0.01	0.13 ± 0.04	232.498	0.000	0.000
	3 Months after intervention	0.05 ± 0.02	0.11 ± 0.03	143.970	0.000	0.000
	6 Months after intervention	0.05 ± 0.02	0.11 ± 0.03	284.022	0.000	0.000

Table 4. Comparison of stereopsis between the two groups

Time Point	Treatment Group (n = 74)	Control Group (n = 76)	F	*P*-value	Post-hoc Test
10 Days after intervention	67.11 ± 1.78	63.57 ± 10.90	3.648	0.058	0.058
1 Month after intervention	62.27 ± 11.69	62.77 ± 12.47	0.064	0.800	0.800
3 Months after intervention	63.08 ± 9.60	60.59 ± 8.74	2.756	0.099	0.099
6 Months after intervention	60.53 ± 9.36	60.89 ± 10.10	0.052	0.820	0.820

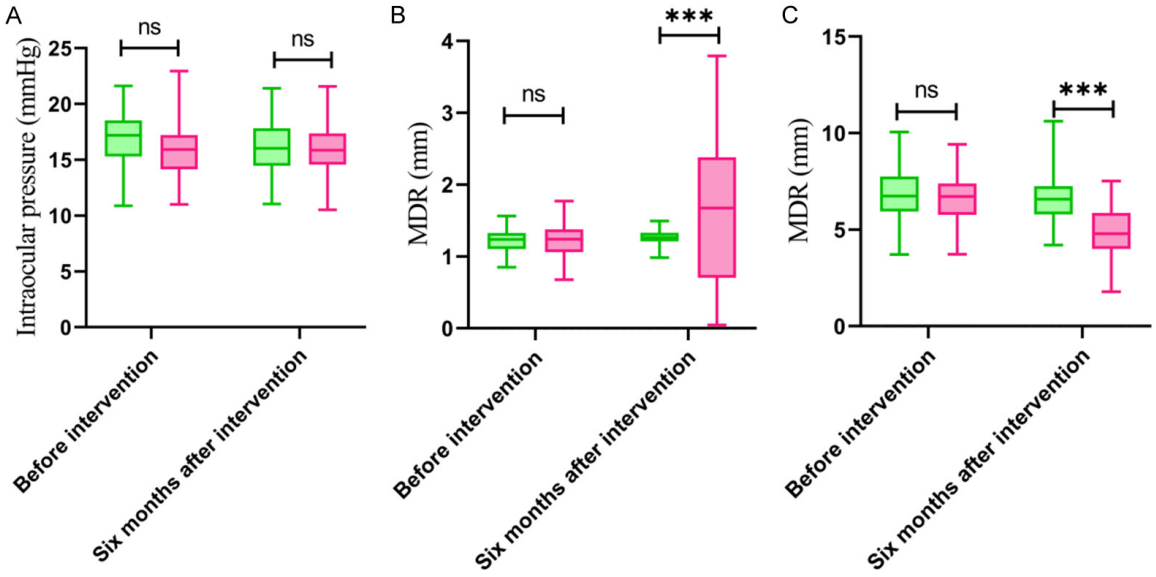

Figure 2. Comparison of corneal biomechanical parameters between the two groups. A. Intraocular pressure, B. MDA, C. MDR. ***P < 0.001, compared to the control group. Note: MDA: Maximum Deformation Amplitude at Maximum Indentation, MDR: Maximum Deformation Curvature Radius at Maximum Indentation.

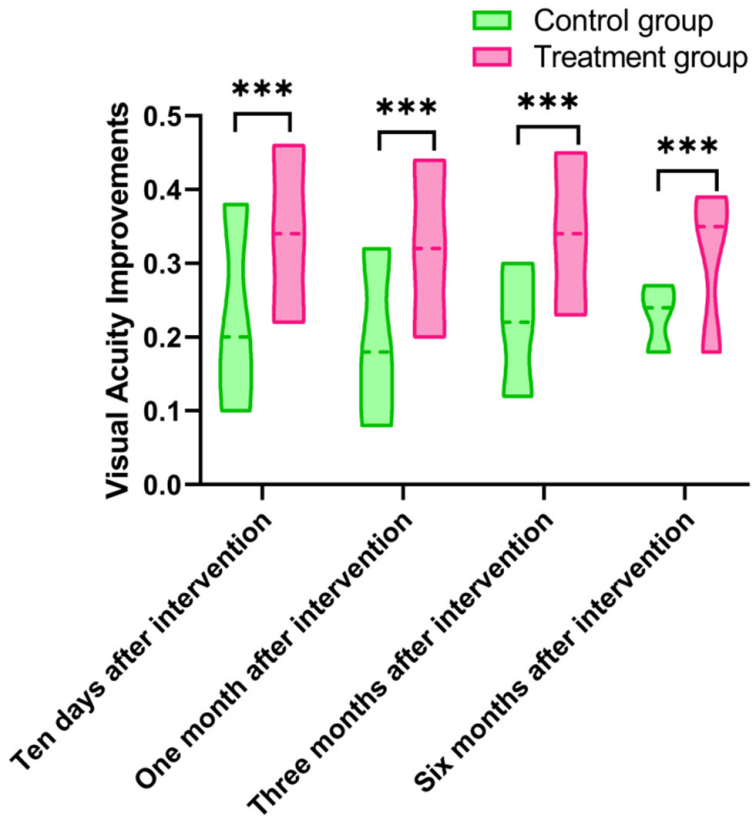

Figure 3. Comparison of long-term stability of visual acuity improvements. ***P < 0.001, compared to the control group.

(**Table 5**). Other variables considered in the regression analysis included spherical equivalent, total HOAs, horizontal coma, vertical coma, spherical aberration, presbyopia treatment using the Sirius Cutting Mode, and age. These results suggest that presbyopic patients who received personalized vision correction with the Sirius Cutting Mode were more likely to experience improved near visual acuity compared to those who did not undergo the treatment.

Discussion

This study provides strong evidence for the effectiveness of the Sirius Cutting Mode in personalized vision correction for presbyopic patients. It highlights significant improvements in both near and distance visual acuity, as well as corneal biomechanical stability. These findings align with recent trends in refractive surgery, where personalized treatments based on individual corneal topography offer superior outcomes compared to traditional one-size-fits-all approaches [14-16].

The treatment group, which received personalized vision correction with the Sirius Cutting Mode, demonstrated better uncorrected distance visual acuity (UDVA) at every follow-up stage (10 days, 1 month, 3 months, and 6 months). The Sirius Cutting Mode consistently enhanced UDVA, showing that this approach customizes the procedure based on each patient's unique corneal features, rather than applying the same treatment for all patients. Personalized treatment likely offers superior vision outcomes by addressing corneal issues that other methods may miss. This study confirms that refractive surgery can help recover both near and distance vision lost due to presbyopia, with results consistent with previous research [17]. These improvements are likely due to the tailored nature of the surgery, which enhances corneal focusing, particularly at the edges, thereby improving near vision.

The observed changes in corneal biomechanical parameters are significant. Both MDA and MDR increased markedly for the treatment group at 6 months post-intervention. These positive changes are likely attributed to the customized cutting technique of the Sirius Cutting Mode, which helps preserve corneal integrity without compromising its strength [18]. The stable IOP levels between the groups suggest that personalized treatment is unlikely to cause changes in corneal stiffness, reducing the risk of corneal ectasia. This finding supports a growing body of literature advocating for the preservation of corneal mechanics during refractive treatments [19, 20]. A custom-

Table 5. Analysis of influencing factors for near visual acuity

Variable	B	SE	Wald	P	OR	95% CI
Presbyopia using the Sirius cutting mode	1.510	0.302	25.013	0.000	4.527	2.505-8.182
Age	0.019	0.017	1.260	0.262	1.019	0.986-1.053
Constant	3.773	1.074	12.356	0.000	0.023	-

ized approach to treating the cornea can maintain its natural shape while achieving optimal refractive results.

Furthermore, we observed a sustained reduction in HOAs in the treatment group. The decrease in spherical aberration, coma, and other HOAs over time underscores the advantage of using the Sirius Cutting Mode to improve visual sharpness and optical quality [21]. Previous studies on wavefront-guided and topography-based treatments also show that these methods improve outcomes by reducing aberrations commonly associated with vision problems. Enhancing these variables may help patients who have undergone explant procedures notice a decline in visual disturbances such as glare and halos, often reported by those who have had traditional refractive surgery [22, 23]. By treating each area of the cornea differently, the likelihood of creating new aberrations is minimized, helping to preserve high visual quality.

The individualized approach of the Sirius Cutting Mode likely contributes to its superior results by improving the reshaping of the cornea. Customizing treatment based on corneal topography helps the Sirius system manage and treat irregular eye shapes that may cause both near and distant vision problems [24-26]. Additionally, wavefront-guided methods can correct high-order errors affecting visual details. This level of precision in surgical treatment likely explains why patients' vision remained improved for six months post-surgery [27]. In combination, better focusing ability, fewer optical aberrations, and stronger corneal biomechanics may explain the long-term success of the treatment, supporting the efficacy of personalized presbyopia correction.

While this research demonstrated significant benefits of the Sirius Cutting Mode, it also has limitations. The 6-month follow-up period did not provide sufficient insight into the long-term stability of the improvements. Future studies with extended follow-up could determine whether the visual and corneal improvements are sustained or additional management is required. The study focused solely on presbyopia patients, and it is uncertain whether similar results would be seen in those with different refractive errors or additional ocular conditions. Further research should test the Sirius Cutting Mode in patients with mixed or multiple refractive errors to assess its broader applicability. Additionally, while this study highlights visual and corneal improvements, the exact biological and cellular mechanisms remain unclear and warrant further investigation.

In conclusion, the Sirius Cutting Mode provided enhanced near and distance vision, while supporting corneal biomechanics. Its ability to reduce high-order aberrations and preserve corneal stability makes it a promising approach for presbyopic patients. The findings suggest that topography-guided, personalized treatments can lead to more durable and superior results. However, further long-term studies are necessary to validate its effectiveness in a wider range of patients.

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Disclosure of conflict of interest

None.

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