Qin *et al. BMC Ophthalmology (2024) 24:383*
https://doi.org/10.1186/s12886-024-03647-8

BMC Ophthalmology

CASE REPORT **Open Access**

Modified technique for sutured scleral fixated intraocular lens in a patient with post-traumatic aniridia and aphakia: a case report

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Abstract

Background A modified surgical technique of sutured scleral fixated intraocular lens (SSF-IOL) was applied in a patient with post-traumatic aniridia and aphakia.

Case presentation A 51-year-old man was referred to our clinic with decreased vision (finger count) in his right eye. This patient had previously undergone primary repair of the ruptured globe and pars plana vitrectomy to manage ocular trauma in the same eye. On presentation, the best corrected visual acuity in his right eye was 20/40. The slit lamp examination of his right eye revealed loss of total iris and lens. Corneal endothelial cell density was 1462 cells/mm^2. Fundoscopic examination of the right eye revealed a retinal attachment. For IOL implantation, a rigid poly methyl methacrylate IOL was used with a 2-point scleral fixation performed using a polypropylene suture. One year postoperatively, the uncorrected distance visual acuity was 20/32, and the manifest refraction was −0.5/−1.5 × 130 (20/20). Pentacam revealed that the astigmatism of the anterior corneal surface and the total cornea was 1.1 D (axis: 59.8°) and 1.0 D (axis: 35.6°), respectively. The horizontal (3°–183°) cross-section image displayed an IOL with a 1° tilt and 0.425 mm decentration. The patient reported no dysphotopsia or photophobia and was satisfied with the visual results. OPD-scan III revealed that higher-order aberrations in the right eye were slightly higher than those in the left eye. No suture-related or other serious complications were observed.

Conclusion The modified SSF-IOL technique can offer improved visual quality for patients with aniridia and aphakia by ensuring proper IOL positioning and reducing astigmatism.

Keywords Aniridia, Aphakia, Sutured scleral fixated intraocular lens (SSF-IOL)

Background

Clinically, addressing the functional issues related to post-traumatic aniridia and aphakia presents significant challenges. Two decades ago, the black diaphragm intraocular lens (IOL) was first applied to address this issue. Although it had been used for a considerable period, it was eventually discontinued due to severe long-term complications, such as corneal endothelial decompensation (CED) and secondary glaucoma [1]. Artificial iris implants have recently gained popularity for treating visual and cosmetic disturbances in eyes with partial or total absence of the iris. However, the occurrence of CED and glaucoma in long-term follow-up cannot be overlooked [2, 3].

Sutured scleral fixated intraocular lens (SSF-IOL) is a viable and relatively prevalent surgical procedure in case of capsular support loss or capsule rupture since its initial report in 1986 by Malbran et al. [4]. The outcome of SSF-IOL implantation and the acceptable safety profiles of the procedure have been demonstrated with the innovations

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in surgical techniques [5, 6]. However, the ideal position of IOL in this surgery is difficult to achieve and is prone to tilt and decentration, which could lead to myopia, hyperopia, or astigmatism. Consequently, it is critical to improve IOL positioning.

This article reports a modified surgical technique of SSF-IOL combined with a steep axial incision applied in a patient with post-traumatic aniridia and aphakia, resulting in excellent refraction and visual quality.

Case presentation

In this study, we present a case of a 51-year-old man with post-traumatic aniridia and aphakia (Fig. 1). In August 2021, the patient's right eye was struck by a branch, resulting in a ruptured eyeball with a scleral laceration extending from 10 to 5 o'clock, 0.5 mm from the limbus, and prolapse of intraocular contents. The patient underwent primary repair of the ruptured globe under local anesthesia. Postoperatively, a slit lamp examination of the right eye revealed aphakia, aniridia, and vitreous hemorrhage. During the first postoperative month, the patient exhibited an uncorrected visual acuity (UCVA) of finger count at 20 cm in the right eye, with vitreous opacity but no retinal detachment as indicated by an Ultrasound B-scan (Quantel Medical, AVISO, France). Two months later, the patient successfully underwent a 25-gauge pars plana vitrectomy (PPV) to remove the opaque vitreous, followed by a sterile air tamponade.

In March 2022, the patient was presented with blurred vision and requested assistance in improving his vision. The UCVA in the right eye was finger count at 20 cm, and the best corrected visual acuity (BCVA) was 20/32 (+9.75/ + 4.5×100). The corneal endothelial cell density was 1462 cells/mm^2. Optical coherence tomography indicated epiretinal membranes but no retinal detachment.

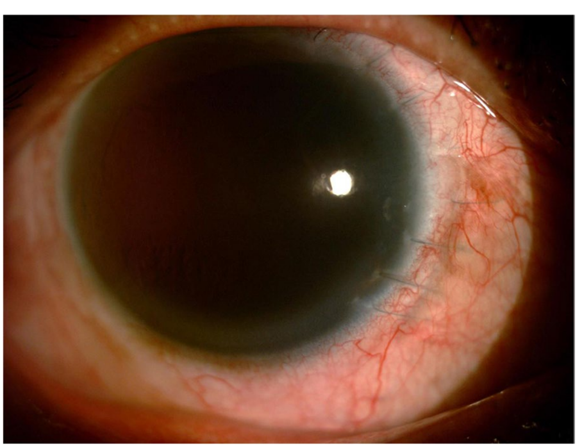

Fig. 1 Preoperative anterior segment of the patient's right eye

A scleral fixated IOL was considered beneficial for the patient. However, photophobia resulting from aniridia might persist, and the IOL implantation could potentially exacerbate glare. Currently, iris diaphragm IOLs are difficult to procure, and their long-term safety remains unknown. While a custom toric IOL is an option for high preoperative corneal astigmatism, considering that the custom toric IOL is a single-piece foldable lens, inevitable twisting may occur when tying both haptics of the IOL, leading to significant tilt or decentration. We explained this dilemma to the patient, and he opted for the SSF-IOL without the implantation of an artificial iris. Typical rigid poly methyl methacrylate (PMMA) IOL designed for suspension has superior long-term stability and relatively larger optics, which could cause minimal dysphotopsia [7–9]. According to the IOL-master biometer (Carl Zeiss Meditec AG, Jena, Germany), the +22.5 D CZ70BD (Alcon Laboratories, Fort Worth, TX, USA) was selected for the patient. Pentacam HR (OCULUS, Typ 70900) revealed that the cornea had about 7.1 D astigmatism with a slight bow shape and a steep axis at 97.8°. It was concluded that an upper incision might reduce this astigmatism.

General anesthesia was administered for the patient as he was uncooperative owing to anxiety and pain. We performed a classical external sutured scleral fixation of the IOL. The following steps were optimized (Fig. 2). We marked 2 and 8 o'clock positions on the limbus with a toric lens marker. A 1.5 mm post-limbus, 7 mm linear scleral tunnel incision was made with a ruler application. Two triangular and half-thickness scleral flaps were constructed at 2 and 8 o'clock positions, approximately 3 mm post-limbus. The entry and exit points of the 9–0 double straight-curved polypropylene suture (1465P, MANI, Japan) were also marked at 2 mm post-limbus under the scleral flaps corresponding to those two points marked previously at 2 and 8 o'clock. An anterior chamber maintainer was placed in the inferior temporal limbus to maintain intraocular pressure with intraocular perfusion fluid. The straight needle of the 9–0 straight-curved polypropylene suture was plunged in through the 8 o'clock marked point. Subsequently, the straight needle then led out at the 2 o'clock marked point. The 9–0 straight-curved polypropylene suture was removed and cut off through the enlarged primary incision. The IOL was tied and inserted carefully. The position of the IOL was found to be perfect, and the incision was closed with a 10–0 nylon suture (AU-1, Alcon Laboratories, Fort Worth, TX, USA).

One day after the operation, the following observations were made: the UDVA was 20/63, and the BCVA was 20/50 (−2.0×180). The intraocular pressure in both eyes was 18 mmHg. The anterior segment was

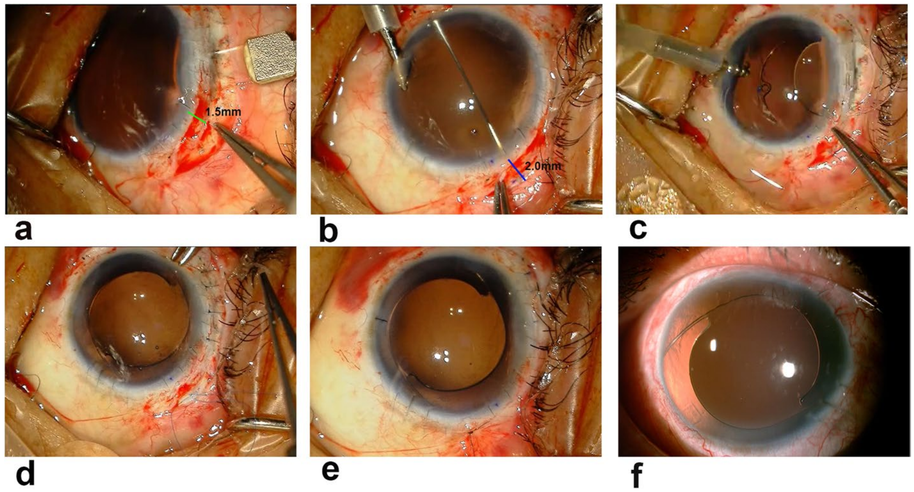

Fig. 2 Procedure steps and results. (**a**) Marked with corneal scale ring and a sterile gentian violet dye surgical pen, two triangular and half thickness scleral flaps were constructed at 2 o'clock and 8 o'clock and made a 7 mm liner scleral tunnel incision (1.5 mm post-limbus, marked in green line) from 12 o'clock to 2 o'clock. (**b**) 9 – 0 double curved polypropylene suture went through the entry point and exit point (2.0 mm post-limbus, marked in blue line) marked with corneal scale ring and a sterile gentian violet dye surgical pen. (**c**) Lens insertion from the enlarged scleral tunnel incision. (**d**) 10 – 0 polypropylene sutured the primary incision. (**e**) End of the procedure. (**f**) Final result 1 month after the operation

quiet, with a transparent cornea and clear aqueous humor.

Three months later, the UDVA was 20/32, and the BCVA was 20/20 (–1.0). The astigmatism of the anterior corneal surface and the total cornea was 0.6 D (deep axis: 70.5°) and 0.4 D (deep axis: 77.4°), respectively (Fig. 3). The corneal endothelial cell density was 1467 cells/mm^2. Cross-sectional images of the anterior chamber and IOL were captured with the Scheimpflug camera (Pentacam HR, OCULUS, Typ 70900) at the horizontal meridians. The horizontal (3°–183°) cross-section image exhibited an IOL with 1° tilt and 0.357 mm decentration (Fig. 4).

One year postoperatively, the visual acuity of the operated eye was stable, with only minor fluctuations in refractive status. The IOL displayed good centering and stability during the follow-up (Table 1). Wavefront

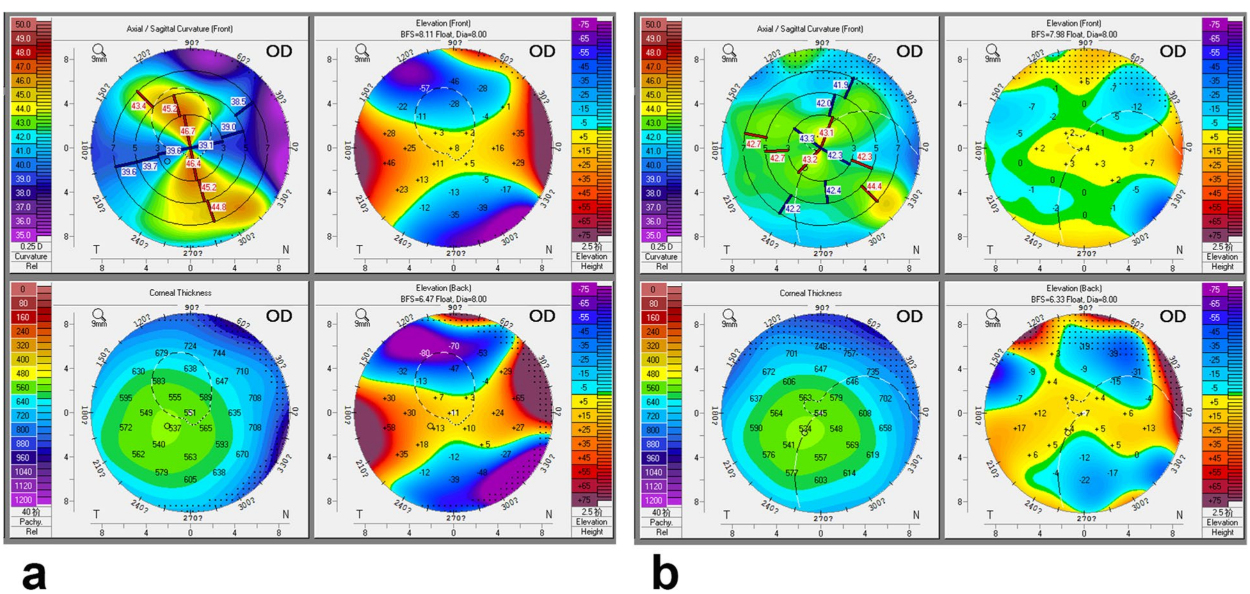

Fig. 3 Scheimpflug tomography of the right eye. (**a**) Preoperative videokeratography of the patient with the steep axis of preexisting corneal astigmatism located at 97.8° (7.1 D). (**b**) The steep meridian shifted to the axis at 70.5° after surgery through a long scleral incision; corneal astigmatism decreased (0.6 D)

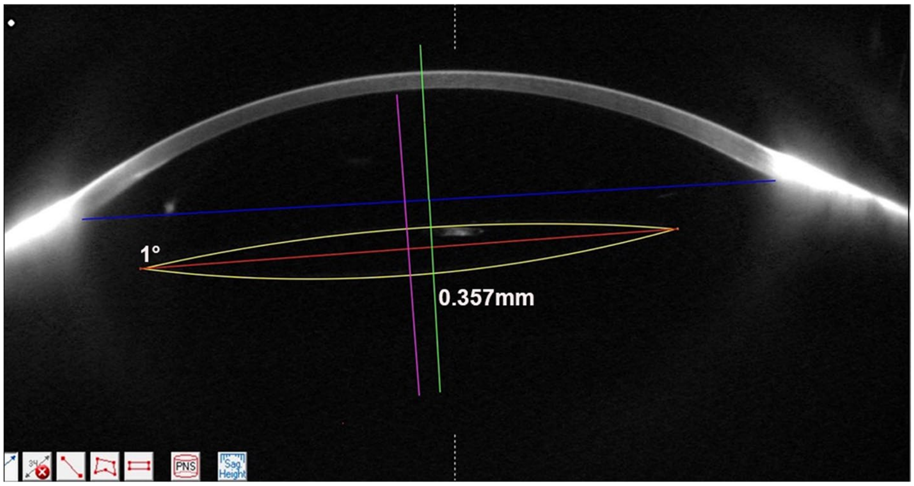

Fig. 4 A horizontal (3°–183°) cross-section image of an IOL with 1° tilt and 0.357 mm decentration 3 months after surgery

Table 1 Main postoperative measures of the right eye

Parameter	1 week	1 month	3 months	1 year
UDVA	0.15	0.7	0.7	0.7
BCDVA	0.6	1.0	1.0	1.0
Refraction	+ 1.0-3.25 × 80	-0.5-0.75 × 140	-1.0	-0.5-1.5 × 130
SimK (D) (Deep Axis)	-	-	0.6(70.5°)	1.1(59.8°)
Tilt (○)	-	-	1	1
Decentration (mm)	-	-	0.357	0.425

analyses were performed using the new-generation corneal topographer, OPD-Scan III (Nidek Co., Ltd., Gamagori, Japan). High-order aberrations (HOAs) of the right and the left eyes were 0.437 mm (Fig. 5G) and 0.215 mm (Fig. 5H), respectively. Point spread function (PSF) and modulation transfer function (MTF) curves and the convolved Snellen charts are illustrated in Fig. 5A–F. The overall trend of postoperative OPD-Scan III aberrometry results of the right eye was good (Table 2).

No IOL dislocation or suture erosion was recorded until the last follow-up. The patient was satisfied with the visual result and experienced a slight glare. Sunglasses were not required indoors or outdoors.

Discussion and conclusions

SSF-IOL is a classical and accessible technique for managing IOL implantation with loss of capsular support or the laxity of the zonule of the lens. With the rapid development and widespread adoption of ophthalmic microscopic techniques, this procedure now exhibits a significantly lower incidence of serious complications compared to earlier methods. Nevertheless, refractive problems of such techniques are contributing factors to impaired visual outcomes. The position of the IOL in the eye can cause myopia or hyperopia after implantation. An asymmetrical suspended IOL could induce internal astigmatism, and a large incision could result in corneal astigmatism. For patients with preoperative high corneal astigmatism and no capsular support, a sulcus-fixated IOL may be a better choice. Therefore, clinicians should consider improving the technique for solving refractive problems.

The IOL position is vital for its optical function. A 2°–3° tilt and 0.2–0.3 mm decentration of IOL are common and clinically unnoticed for any IOL design [10]. A theoretical model eye study demonstrated that more than 1 mm IOL decentration and more than 5° tilt could be visually significant, causing oblique astigmatism [11]. Regarding IOL implanted in a capsular bag, the tilt of the IOL is minimal without significantly impacting refractive function. However, in SSF-IOL surgery, achieving perfect symmetry at the two points where the IOL is fixed to the sclera is challenging. The closer the distance from the points to the limbus, the less tilt of the IOL. The decentration of the IOL in this surgery mainly depends on the two-point alignment of the clock positions. We marked

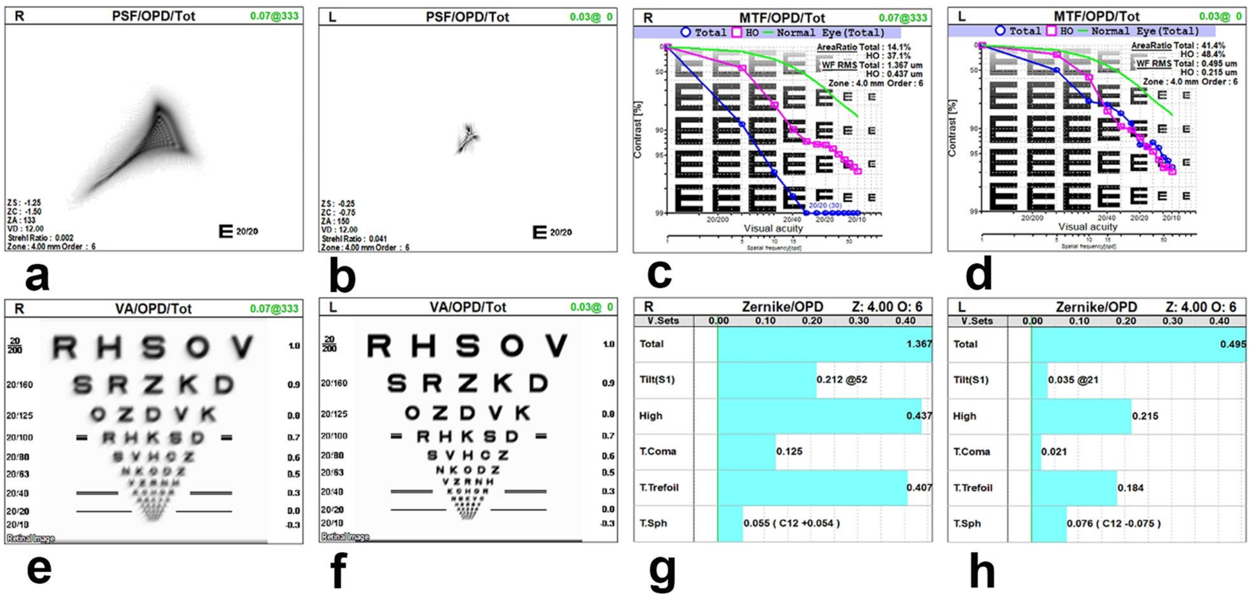

Fig. 5 Nidek OPD-Scan III topography of the patient's both eyes one year after surgery. (**a**) PSF of the right eye. (**b**) PSF of the left eye. (**c**) MTF graphs of the right eye. (**d**) MTF of the left eye. (**e**) Changes in the simulated BCVA of the right eye. (**f**) Changes in the simulated BCVA of the left eye. (**g**) Ocular aberrations of the right eye. (**h**) Ocular aberrations of the left eye

Table 2 Postoperative OPD-Scan III aberrometry results of both eyes

Parameter		Right eye	Left eye
Zernike/OPD			
	Tilt	0.212@52	0.036@21
	High	0.437	0.215
	T. Coma	0.125	0.021
	T. Trefoil	0.407	0.184
	T. Sph	0.055(C12 + 0.054)	0.076(C12 -0.075)
Zernike/Corn			
	Tilt	0.282@157 0.248	0.063@58
	High	0.248	0.093
	T. Coma	0.135	0.039
	T. Trefoil	0.157	0.051
	T. Sph	0.031(C12 + 0.031)	0.049(C12 + 0.047)
Zernike/Int			
	Tilt	0.396@8	0.041@269
	High	0.344	0.215
	T. Coma	0.215	0.020
	T. Trefoil	0.251	0.162
	T. Sph	0.026(C12 + 0.023)	0.124(C12 -0.123)

the clock position with the toric lens marker and used the ruler to attain a similar distance from the points to the limbus. Consequently, we obtained two nearly perfect points with the best symmetry. In our case, the tilt of the IOL was only 1°, comparable to those implanted in a capsular bag. The decentration of the IOL was 0.357 mm, which is within acceptable limits for IOL implantation.

IOL haptic design significantly influences IOL tilt and decentration [12, 13]. The CZ70BD IOLs, rigid PMMA lenses with a 7.0 mm optic diameter, a 12.0 mm total length, and two haptics in a C-loop configuration with small eyelets at the apex of each haptic, are the preferred choice in the clinic for ensuring safety and stability in IOL suspension. Although single-point fixation of the haptic is typically a significant risk factor for IOL rotation—particularly in foldable IOLs—CZ70BD seems showed little rotation in our case. Nevertheless, a 7 mm primary incision could induce a sizeable corneal astigmatism. In this case, the patient required a larger optical zone due to aniridia. Long-term safety is crucial for patients with relatively low corneal endothelial cell counts following trauma and multiple surgeries. The CZ70BD IOL features eyelets optimally positioned within the haptics for secure suture fixation, preventing knot slippage. Additionally, a large upper incision can reduce the vertical K value of the cornea.

As anticipated, the patient's corneal astigmatism decreased after the operation. Pentacam displayed 7.1 D astigmatism in the anterior surface and 1.1 D in the posterior surface preoperatively, dropping significantly to 0.6 and 0.4 D, respectively, three months postoperatively. After one year, the corneal astigmatism remained low. The extremely high corneal astigmatism could be induced by the repair of the ruptured eyeball. Relaxing incisions in the cornea or limbus at the steep meridian has been an accepted technique to reduce corneal astigmatism and is used extensively in clinics [14]. It was reported that opposite clear corneal incisions with 4 mm incisions on the steep meridian can reduce about 1.0 diopter [15]. For our patient, we made an 8 mm scleral incision at the steep meridian and secured it with several tight sutures. These procedures may flatten the cornea in the vertical direction, which is depicted by Pentacam as a decreased K2 (from 46.1 D before the operation to 42.4 and 42.2 D three months and one year after operation, respectively). In contrast, K1 increased by 2.0 D (from 39.2 D before the operation to 41.9 and 41.2 D three months and one year after operation, respectively). The 2.0 D increase in K1 and 4 D decrease in K2 resulted in corneal astigmatism of only 0.5 D at three months and 1.0 D at one year after operation. The suspended IOL exhibited a 1° tilt, similar to that observed in capsule bag implantation. This, combined with low corneal astigmatism and a slightly tilted IOL, contributed to an optimal visual outcome.

The OPD-Scan III revealed that the HOAs in the surgical eye were slightly higher than in the normal eye. In this case report, the amounts of corneal HOAs, corneal coma-like, and spherical-like aberrations in the postsurgical eye were 0.344, 0.215, and 0.026 μm, respectively, comparing favorably with the previous data. Adem Tellioˇglu et al. [16]. reported the mean and standard deviation of corneal HOAs in the eyes with sutured IOL for a 6 mm pupil was 1.15 ± 1.02 μm and corneal coma-like and spherical-like aberrations were 0.53 ± 0.52 and 0.21 ± 0.12 μm, respectively. In our case, the lower corneal HOAs, along with minimal tilt and decentration of the IOL, likely contributed significantly to the good results.

Postoperatively, the patient rarely complained of dysphotopsia and photophobia caused by aniridia. According to some researchers, PMMA material, round edges, and a bigger optic diameter are associated with a decreased incidence of dysphotopsia [17–19]. The CZ70BD IOL used in our patient possessed these characteristics. The reduction in corneal astigmatism and the implantation of intraocular lenses help focus the light reaching the retina more precisely, which could contribute to reducing photophobia.

Our patient's vitreous cavity was filled with water instead of vitreous due to PPV surgery; accordingly, it was crucial to maintain intraocular pressure balance during the procedure. Using an anterior chamber, the maintainer significantly avoided the piercing difficulty caused by ocular deformation and prevented choroidal detachment and intraocular hemorrhage. To maintain intraocular pressure balance during the surgery, the main incision was sutured first, followed by the fixation of the two IOL haptics. When adjusting the main incision at the end, efforts were made to suture it as tightly as possible to reduce corneal astigmatism. The crucial point of this technique used in this patient was to fix the two haptics of the IOL symmetrically in the sclera and ensure the primary incision was positioned in the steep axial as neatly as possible. This technique created relatively perfect refraction for the SSF-IOL eye, benefiting patients suffering from aniridia and aphakia.

The absence of the lens's posterior capsule is a known risk factor for endophthalmitis due to infection. To reduce this risk, it is crucial to apply antibiotic eye drops before surgery to prevent infection, disinfect the conjunctival sac with povidone-iodine, avoid exposing eyelashes to the surgical field during the procedure, and ensure all incisions are properly closed at the end of surgery. In this study, we addressed all these aspects except for an oversight where some eyelashes were inadvertently exposed to the surgical field.

In conclusion, although technically challenging, the modified SSF-IOL technique enables the preservation of nearly normal ocular architecture while achieving excellent refractive outcomes and no subjective complaints.

Abbreviations

SSF-IOL	Sutured scleral fixated intraocular lens
PPV	Pars plana vitrectomy
BCVA	Best corrected visual acuity
PMMA	Rigid poly methyl methacrylate
IOL	Intraocular lens
UDVA	Uncorrected distance visual acuity
OCT	Optical coherence tomography

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12886-024-03647-8.

Additional file 1. A surgical video of right eye manifests the major procedures

Acknowledgements
We thank Home for Researchers editorial team (www.home-for-researchers.com) for language editing service.

Authors' contributions
HLQ drafted the manuscript and collected patient information, HGW edited the surgery video and photos, YCK and FYH collected the follow-up data, XL critically revised the manuscript for intellectual content and supervised the project. All authors read and approved the final manuscript.

Funding
This work was supported by the National Natural Science Foundation of China (Grant number 81,360,144, China) and the Natural Science Foundation of Guangxi Province (Grant number 2017GXNSFAA198250, Guangxi, China).

Availability of data and materials
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The study was approved by the review board of The First Affiliated Hospital of Guangxi Medical University.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and related images and videos.

Competing interests
The authors declare no competing interests.

Received: 29 November 2023 Accepted: 19 August 2024
Published online: 30 August 2024

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