

A modified intrascleral intraocular lens fixation technique with fewer anterior segment manipulations: 27-gauge needle-guided procedure with built-in 8-0 absorbable sutures

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Abstract

Background To report a modified surgical technique for intrascleral intraocular lens (IOL) fixation with fewer anterior segment manipulations in eyes lacking sufficient capsule support. **Methods** Eyes from 14 patients who underwent 27-gauge needle-guided intrascleral IOL fixation with built-in 8-0 absorbable sutures were studied. The 8-0 absorbable sutures were inserted into 27-gauge round needles and used to create angled sclerotomies at the 4 o'clock and 10 o'clock positions under the scleral flap. The sutures were used to tie knots at the ends of the haptics and guide haptic externalization through sclerotomy. After externalization, a sufficient flange was created at the end of the haptics and fixed under the scleral flaps. The best corrected visual acuity (BCVA), previous surgery history, and complications were determined. **Results** Fourteen cases were analyzed. The majority of eyes exhibited an improvement in BCVA after surgery. When comparing the last follow-up to preoperative visual acuity, the mean change in BCVA was + 26.32 letters ($p=0.011$). Postoperative complications included postoperative hypotony in 3 eyes, ocular hypertension in 2 eyes. No postoperative cystoid macular edema, vitreous hemorrhage, IOL dislocation, or endophthalmitis was observed. **Conclusions** The 27-gauge needle-guided intrascleral IOL fixation technique with built-in 8-0 absorbable sutures is easy to manipulate with fewer anterior chamber manipulations and achieves both anatomical and optical stability.

Background

Surgical techniques for intraocular lens (IOL) implantation in an eye without sufficient posterior capsular support include anterior chamber IOL implantation, iris-fixed IOL implantation, or transscleral-fixated IOL implantation.[1-5] Currently, intrascleral fixation of posterior chamber IOL implantation is widely performed because of its safety, effectiveness, and stability.

The intrascleral IOL fixation technique was first formulated by Gabor and Pavlidis in 2007 and further detailed by Agarwal and colleagues; additionally, several modifications to this technique have been reported.[6-8] Among those techniques, Yamane developed double-needle technique and flanged IOL fixation technique that can provides good IOL fixation with firm haptic fixation without using special surgical instruments and suture. Meanwhile, these two techniques have an advantage of being simple and requiring less surgical time.[1,2] However, several remaining issues need to be resolved. First, the IOL haptic externalization procedure might be too complicated to manipulate and could cause deformation of the IOL haptics, especially in eyes with a small pupil.[2-3, 9, 10] Second, previously reported methods require many manipulations in the anterior chamber, potentially causing anterior segment complications, such as corneal decompensation.[11] Third, there are potential risks of IOL falling into the vitreous cavity, haptic extrusion or exposure to the external environment, which might lead to endophthalmitis. Therefore, performing intrascleral IOL fixation, a relatively sophisticated technique, might be difficult for beginners or surgeons with limited experience. A longer learning curve might be required.[12]

Here, we report a reliable surgical procedure, a 27-gauge needle-guided intrascleral IOL fixation with built-in 8-0 absorbable sutures. This technique requires no special instruments for the IOL fixation and fewer anterior chamber manipulations. Moreover, the haptics of the IOL can be easily externalized through sclerotomy. We performed this technique in a series of eyes without sufficient posterior capsular support, such as those with

complex ocular trauma or other aphakia. Based on our results, this technique provides well IOL fixation with acceptable wound closure.

Methods

Patients and Methods

Fourteen eyes of 14 patients who underwent 27-gauge needle-guided intrascleral IOL fixation with built-in 8-0 absorbable sutures between May 2017 and July 2018 were retrospectively evaluated. All surgeries were performed by the same experienced surgeon (Z.Y. W) at Shanghai Ninth People's Hospital, Shanghai Jiaotong University School of Medicine. This study adhered to the tenets of the Declaration of Helsinki. Ethics Committee approval was obtained from the Shanghai Ninth People's Hospital review board. Informed consent was obtained from all patients or their parents and the possible complications of the procedure were explained.

We obtained medical records containing information on demographics and the reason for surgery. Standard ophthalmologic examination records, such as initial best-corrected visual acuity (BCVA), slit-lamp evaluation (SL-D7, Topcon, Tokyo, Japan), intraocular pressure (IOP), length of follow-up, final visual acuity, postoperative ultrasound biomicroscopy (UBM) (SW-3200, Suoer, Tianjin, China) and spectral domain optical coherence tomography (OCT) (TR-KT-2913, Heidelberg Engineering GmbH, Heidelberg, Germany) were also obtained.

The Wilcoxon signed-rank test was used to determine the significance of any association between preoperative and postoperative BCVA. A p-value less than 0.05 was considered significant. Statistical analyses were performed using SPSS for Mac software (version 25.0, IBM corp., NY, USA).

Surgical technique

Under preoperative preparation and peribulbar anesthesia, two two-thirds thickness limbal-based scleral flaps (3.0×3.0 mm) were created at the 4 o'clock and 10 o'clock positions. A superior 3.0 mm corneal tunnel incision was created. An infusion cannula or anterior chamber maintainer was inserted to protect the corneal endothelium.

The 8-0 absorbable sutures (L-2748K, Covidien, Massachusetts, USA) were inserted into a 27-gauge round needle, which was used to create an angled sclerotomy at 2.0 mm from the limbus, 180 degrees apart diagonally, under the previously created scleral flap. Forceps were used to grasp the 8-0 absorbable sutures and externalize the sutures through the previously created 3.0 mm corneal tunnel. A 3-piece IOL (AR40e, Advanced Medical Optics, Santa Ana, America) was placed into the injector, and the ends of the leading haptic were extruded and cauterized to a small flange by an ophthalmic cautery device. The 4 o'clock 8-0 suture was then used to tie several knots at the ends of the leading haptics. A satisfactory suture fixation could be achieved by making the first flanged end approximately 1.2 times larger than the bare haptics. The main purpose of this flanged end was to allow the 8-0 suture to anchor. Then, the 3-piece IOL was then inserted into the anterior chamber by the injector, and the trailing haptic was kept outside to prevent the IOL from falling into

the vitreous cavity. The trailing haptic was cauterized, tied to the 10 o'clock 8-0 suture and then carefully inserted into the anterior chamber. A U-hook was used to guide the IOL to the center of the pupil. The suture was then grabbed with forceps to externalize the haptics through sclerotomy.

After externalization, a sufficiently large flange was created at the end of the haptics and inserted into the sclera for firm fixation. According to our experience, a satisfactory IOL fixation can be achieved by making the second flanged end approximately 1.5 times larger than the bare haptics. The main purpose of this flange is to prevent haptics from slipping off. The haptics were then buried under 3.0 mm scleral flaps. Then the scleral flaps were closed by fibrin glue, which will increase efficiency without affecting the efficacy of the surgery.[8] (Figure 1) Topical steroids were used in all patients postoperatively. The duration of surgery was recorded by video. (see Video, supplementary file 1).

Results

The haptics were well fixed and the IOL was centrally positioned in all 14 eyes of 14 patients (11 males, 3 females; mean age, 45.86 ± 19.14 years old, range, 7-74 years old). The mean follow-up period was 9.57 ± 2.87 months (range, 6-15 months). All patients had associated ocular conditions such as complicated ocular trauma (9 eyes), proliferative diabetic retinopathy (3 eyes) and primary retinal detachment (2 eyes). Some patients had complications before surgery (for example, iridodialysis, traumatic glaucoma or endophthalmitis).

The BCVA was measured as the total number of letters on the Early Treatment Diabetic Retinopathy Study (ETDRS) visual acuity chart when assessed at a starting distance of 4 meters. When comparing the last follow-up to preoperative visual acuity, the mean change in BCVA was + 26.32 letters. The mean BCVA was 1.18 ± 0.70 logarithm of the minimum angle of resolution (logMAR) units preoperatively and 0.64 ± 0.60 logMAR units at the last follow-up postoperatively, which had statistically significant differences ($P=0.011$). However, the BCVA did not improve in 4 cases during the follow-up period. In 2 cases, patients had severe proliferative diabetic retinopathy with poor visual acuity before surgery. In 1 case, the patient had complicated ocular trauma. In 1 case, the patient had rhegmatogenous retinal detachment. Since nearly two-thirds of cases had ocular trauma and other cases had either retinal detachment or proliferative diabetic retinopathy, some of our patients had unsatisfactory visual outcomes because of their underlying pathology. Postoperative complications included postoperative hypotony in 3 eyes and transient ocular hypertension in 2 eyes, which resolved within 1 month without further significant complications. No other major perioperative or postoperative complications (e.g., wound leakage, vitreous hemorrhage, endophthalmitis, cystoid macular edema, serous choroidal detachment, or retinal detachment) were detected during the follow-up period. Table 1 shows preoperative and postoperative medical records of the patients.

Discussion

Recently, the intrascleral posterior chamber IOL fixation technique has become popular because of its stability and proximity to the physiological anatomic position of the original lens.[1-3] The most common indication for this procedure includes posttraumatic aphakia, aphakia after complex cataract surgery, or after lensectomy

during complex surgical procedures, such as retinal detachment repair, IOL dislocation, or crystalline lens subluxation.[13]

There are two surgically challenging steps in intrascleral-fixated IOL procedures.[6] The first is the externalization of IOL haptics. The intraocular forceps technique was reported by Gabor and Pavlidis,[7] but this technique might cause deformation of the IOL haptics. The double-needle technique, which was reported by Yamane, might make it difficult to grasp the second haptic and insert it into a scleral tunnel after the first haptic is externalized.[1-2] Therefore, compared with other techniques, our approach solved the problem of the difficulty in grasping the second haptic after the first haptic was externalized. Meanwhile, it can minimize the risk of multiple anterior segment manipulations. It is a simple and reliable surgical technique, which is suitable for beginners or surgeons with limited experience. Each step of this technique is simple so that it is easy to manipulate with short learning curve. In our procedure, we used a disposable 27-gauge syringe needle to create the sclerotomy and inserted a lead 8-0 suture into the posterior chamber to guide the externalization of the haptics. During the externalization, there was no risk of the IOL falling into the vitreous cavity because the sutures was used to tie knots at the ends of the haptics. Since large diameters sclerotomy can result in wound leakage and postoperative hypotony, we chose 27-gauge needles, which caused minimal damage to the conjunctiva and sclera and created a self-sealing angled sclerotomy wound.[14] No other intraocular surgical instruments or manipulations were required at this step, which minimized possible damage to the cornea, peripheral retina, and other intraocular tissues. Fewer anterior segment manipulations may result in faster postoperative visual rehabilitation and a lower risk of anterior segment complications, such as corneal decompensation.[15-16]

The second surgically challenging step in this procedure is the fixation of the IOL haptic inside the scleral tunnel. Intrascleral IOL fixation techniques are classified into those with and those without a scleral flap.[2-3] The technique without a scleral flap is simpler and does not require sutures or fibrin glue. However, there is a potential risk of haptic extrusion. Unstable intrascleral fixation may cause IOL decentration or dislocation, which may impact refraction and visual function.[17-18] IOL haptic fixation is easily accomplished using the technique with the scleral flap, but the surgical procedure is relatively complex.[2] However, the possibility of haptics extrusion and slipping into vitreous cavity by simply using flanged end fixation can be well prevented by the scleral flap.[12, 19] Making appropriate flanged ends is a critical process in our approach. During our procedure, we flanged the haptics end prior to placement into the anterior chamber, approximately 1.2 times larger than the bare haptics. The main purpose of the first flange is to allow the 8-0 sutures to anchor. In the final stage of the surgery, we cauterized and created a sufficient flange at the end of the haptics, approximately 1.5 times larger than the bare haptics, and inserted it into the scleral tunnel. The main purpose of the second flange is to prevent haptic from slipping through the tunnel.[1] Moreover, the haptics were buried under 3.0 mm scleral flaps, which can minimize the risk of haptic extrusion or dislocation, and prevent IOL from falling into the vitreous cavity. This technique achieved a secure and stable fixation of the haptic in the intrascleral tunnel.

According to Sindal, eyes with posttraumatic aphakia have better visual outcomes after scleral-fixated IOL implantation. Although there can be long-term suture-related complications from IOL implantation, including suture degradation or breakage associated with IOL decentration or dislocation, there were no differences in outcomes and complication rates observed between sutured and sutureless sclera-fixated IOL implantation techniques.[20] We buried the haptics under scleral flaps, and the scleral flaps were closed by fibrin glue, which

will increase efficiency without affecting the efficacy of the surgery.[8] UBM and anterior segment OCT demonstrated a securely fixated IOL and well-centered optic (Figure 2).

According to a large retrospective study by Todorich, the most common complications after intrascleral-fixed IOL surgery were vitreous hemorrhage and cystoid macular edema.[16] The major postoperative complications of our procedure were postoperative hypotony (3 of 14 cases) and transient ocular hypertension (2 of 14 cases), which return to normal intraocular pressure range within one month without further complications. No vitreous hemorrhage and cystoid macular edema were detected during the follow-up period.

There are limitations to our study, including a small sample size, short follow-up period, and lack of control group. In these 14 cases, there was no evidence of IOL decentration and dislocation, no severe complications, and no haptic erosion during the follow-up period.

In conclusion, our 27-gauge needle-guided intrascleral IOL fixation technique with 8-0 absorbable sutures might be useful for IOL implantation in eyes without sufficient capsule support. This technique is easy to manipulate and achieves both anatomical and optical stability, which has fewer potential risks of IOL decentration and dislocation. However, a longer follow-up observation is required to examine the long-term anatomic and functional outcomes associated with this technique.

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Abbreviations

IOL intrascleral intraocular lens

BCVA best corrected visual acuity

IOP intraocular pressure

UBM ultrasound biomicroscopy

OCT optical coherence tomography

ETDRS Early Treatment Diabetic Retinopathy Study

logMAR logarithm of the minimum angle of resolution

M male

F female

OT ocular trauma

CLS	crystalline lens subluxation
CCE	concomitant cataract extraction
CLD	crystalline lens dislocation
RRD	rhegmatogenous retinal detachment
RD	retinal detachment
MH	macular hole
PDR	proliferative diabetic retinopathy
VH	vitreous hemorrhage

Declarations

Ethics approval and consent to participate: This study adhered to the tenets of the Declaration of Helsinki. Ethics Committee approval was obtained from the Shanghai Ninth People's Hospital review board.

Consent for publication: As this was a retrospective study, consent for publication could not be obtained from all patients because some of them were unable to be contacted. We provided ages as age-ranges to protect participant anonymity in Table 1.

Availability of data and material: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests: All authors declare that they have no competing financial interests and proprietary interest in relation to the work described.

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Authors' contributions: Z.Y. W. takes responsibility for the integrity and the accuracy of the data analysis. Z.Y. W. contributed to the study design, performed the surgeries, and collected the samples. Y. Y. and T.T. Y. analyzed the data, wrote the first draft of the manuscript and edited the subsequent revisions. Y.L. Z contributed to the study design and oversaw the implementation of the study protocol. Y.X. W. reviewed, edited, and approved the final manuscript. All authors have read and approved the manuscript.

Tables

Table.1. preoperative and postoperative medical records of the patients

Cases	Sex	Age- Ranges	Eye	Preexisting Ocular Disease	Preoperative BCVA	Postoperative BCVA	Follow- up (Months)	Postoperative Complications
1	M	30-35	R	aphakia, OT, eyeball rupture, iridodialysis	0.15	0.00	15	—
2	M	45-50	L	CLS, OT, RD	0.22	0.10	8	—
3	M	20-25	R	CLS, OT, glaucoma, MH	2.00	0.40	13	transient ocular hypertension(25mmHg)
4	M	45-50	R	CLS, OT, iridodialysis	1.30	0.10	9	transient ocular hypertension(26mmHg)
5	F	55-60	L	CCE, PDR, VH, RD*	1.30	1.52	8	—
6	M	30-35	L	CLD, OT, VH, RD, iridodialysis,	2.00	1.52	14	—
7	F	60-65	L	aphakia, PDR, VH	2.00	0.40	11	postoperative hypotony(5mmHg)
8	M	60-65	L	aphakia, RRD*	0.52	0.52	10	—
9	M	25-30	R	aphakia, OT, iridodialysis, sympathetic ophthalmia*	0.40	0.52	6	postoperative hypotony(3mmHg)
10	F	55-60	R	aphakia, RRD, high myopia	1.52	0.70	8	postoperative hypotony(7mmHg)
11	M	65-70	L	CLS, OT, retinal tears	1.52	0.40	8	—
12	M	70-75	L	aphakia, PDR*	2.00	2.00	7	—
13	M	5-10	L	aphakia, OT, endoophthalmitis	0.70	0.52	11	—

14 M 45-50 L CCE, OT 0.82 0.30 6 —

M=male; F=female; OT=ocular trauma; CLS=crystalline lens subluxation;

CCE=concomitant cataract extraction; CLD=crystalline lens dislocation;

RRD=rhegmatogenous retinal detachment; RD=retinal detachment; MH=macular hole;

PDR=proliferative diabetic retinopathy; VH=vitreous hemorrhage; BCVA=best-corrected visual acuity;

* BCVA did not improve

Figures

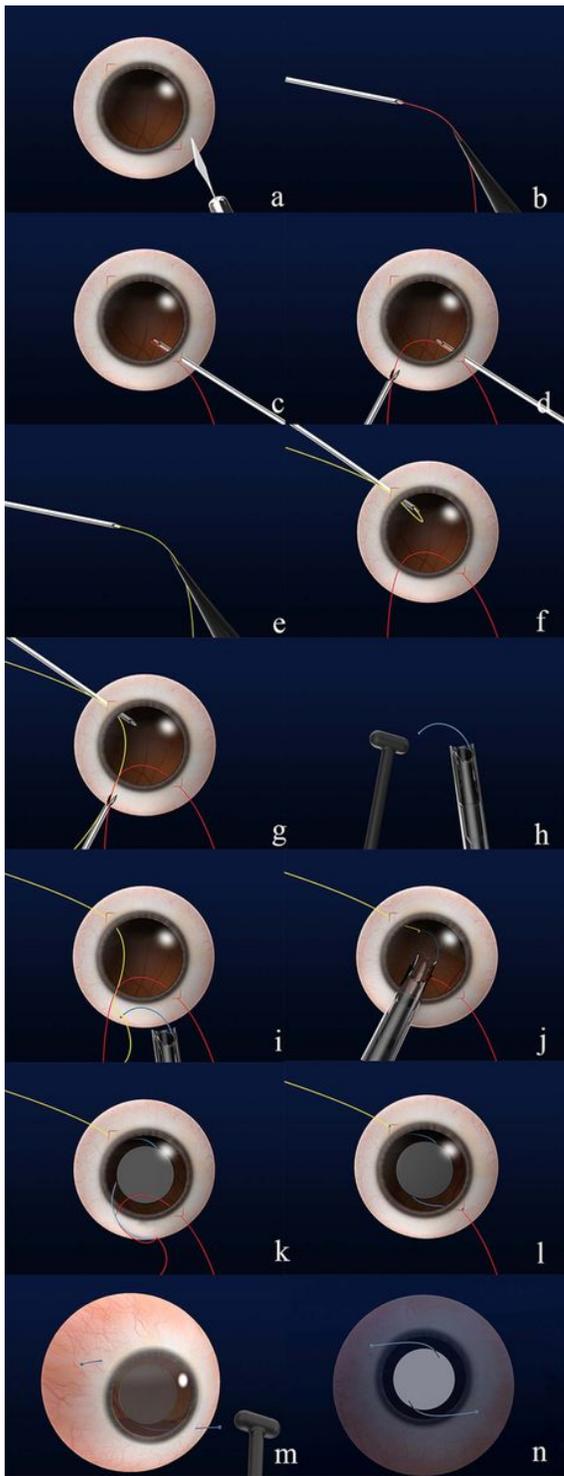


Figure 1

27-gauge needle-guided intrascleral IOL fixation with 8-0 absorbable suture surgical technique. a. Two two-thirds thickness limbal-based scleral flaps were created. b. Absorbable sutures were inserted into a 27-gauge round needle. c. The needle was used to create an angled sclerotomy at the 10 o'clock position, under the previously created scleral flap. d. Absorbable sutures were used for externalization. e.f.g. 4 o'clock manipulation. h. The ends of the haptic were then used to cauterize to a small flange. i. Several knots were tied at the ends of the leading haptics. j.k. A 3-piece IOL was inserted into the anterior chamber. l. The suture was

then used to externalize the haptics. m. A sufficient flange at the end of the haptics was created and inserted into the scleral. n. The wound was closed.

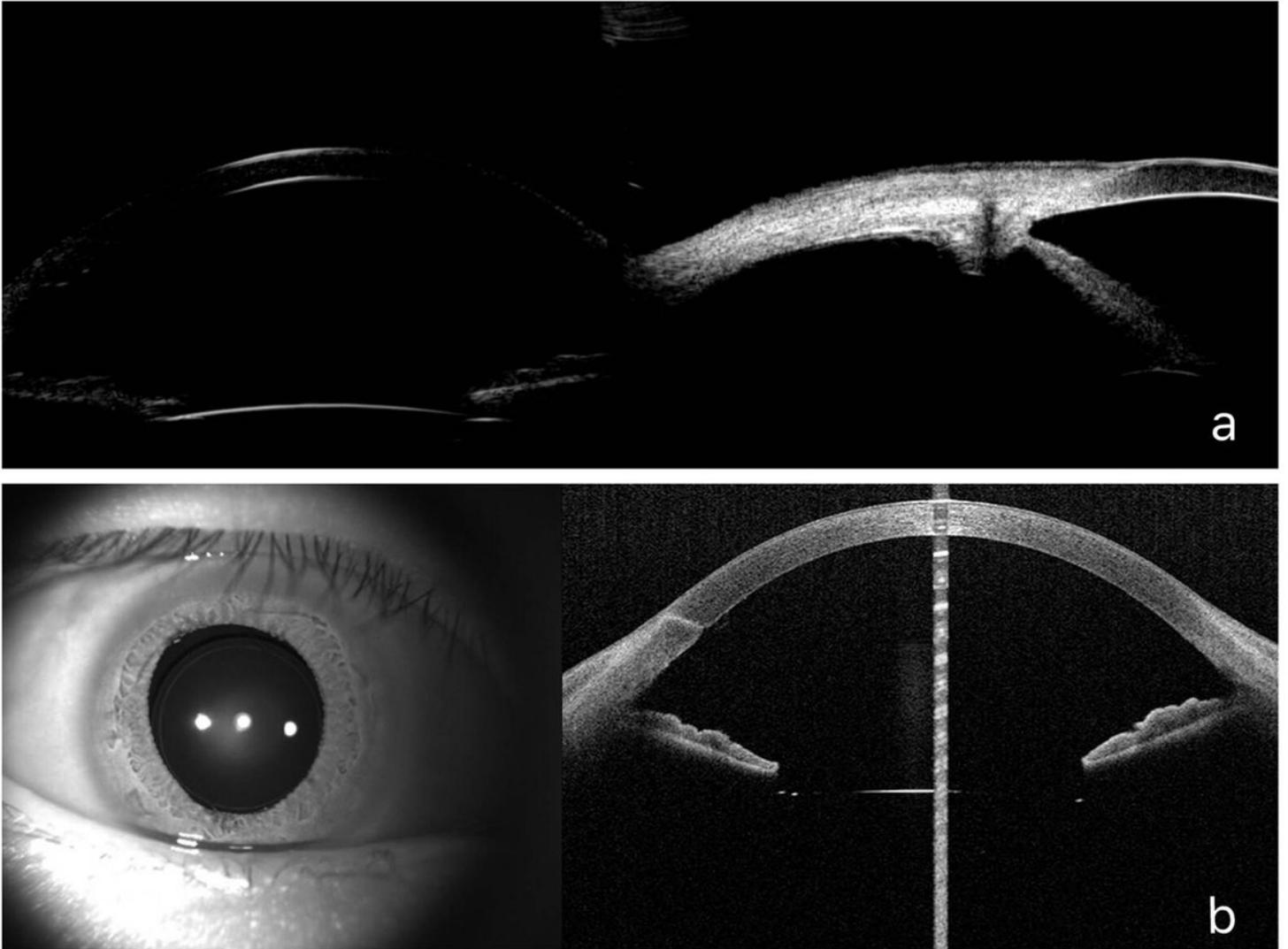


Figure 2

Clinical records of a representative patient after 13 months of surgery (Case 3) a. UBM image. b anterior segment optical coherence tomography image.

Supplementary Files

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