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Case Report

A Case of Pigment Dispersion Syndrome after Placement of Sulcus Intraocular Lens with 7-mm Optic Diameter after Posterior Capsule Rupture

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Keywords
Pigment dispersion syndrome · Intraocular lens · Posterior capsule rupture · Optic diameter · Sulcus intraocular lens placement

Abstract
A 48-year-old woman diagnosed with primary angle closure suspect (PACS) in the right eye underwent cataract surgery, and a 7-mm optic diameter intraocular lens (IOL) was placed in the ciliary sulcus after intraoperative posterior capsule rupture. The patient developed uveitis and blurred vision the next day. The IOL was fixed between the iris and the anterior capsule. Irregularly shaped pupils due to posterior synechia and pigmentation on the IOL surface were observed. In the Scheimpflug image, the IOL on the anterior capsule was observed and the anterior chamber depth was 2.92 mm. A diagnosis of pigment dispersion syndrome and elevated intraocular pressure due to sulcus IOL placement was made. The patient underwent intrascleral IOL fixation surgery using an already inserted IOL to reposition the IOL under the anterior capsule. After 1 week, the blurred vision, anterior chamber inflammation, and IOL surface pigmentation were resolved. The right eye IOP was 15 mm Hg and the pupil became a regular circle. Scheimpflug images showed the IOL located behind the anterior capsule and an anterior chamber depth of 3.88 mm. Because the patient had a slightly shorter axial length of 22.89 mm and PACS, pigment dispersion may have occurred due to friction between the iris and the shape of the optic edge with a large optic diameter. In cases of posterior capsule rupture with short axial length and PACS, the use of a 7-mm optic diameter IOL in the sulcus should be avoided, or intrascleral IOL fixation should be selected as the surgical technique.

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Introduction

Sulcus intraocular lens (IOL) placement, which fixes the IOL between the iris and anterior capsule, is a procedure used for posterior capsule rupture during cataract surgery. The sulcus placement of a single-piece IOL may cause pigment dispersion syndrome accompanied by glaucoma, which is further accompanied by high intraocular pressure (IOP). Therefore, a three-piece IOL with thin haptics should be used for this procedure [1, 2]. To date, the 6-mm optic diameter three-piece IOL has been conventionally used; however, in recent years, three-piece IOLs with a 7-mm optic diameter have been clinically used [3, 4]. In previous studies, the postoperative results after sulcus placement of the three-piece IOL have been reported using a 6-mm optic diameter IOL. Thus, there are many unclear points regarding the postoperative course and complications of sulcus placement of a large IOL with a 7-mm optic diameter. In this article, we report a case of pigment dispersion syndrome after sulcus placement of an IOL with a 7-mm optic diameter.

Case Presentation

A 48-year-old woman was diagnosed by a local ophthalmologist with cataract and primary angle closure suspect (PACS) and underwent cataract surgery of the right eye in June 2020. There was no noteworthy medical or family history. An IOL (NX-70S, +23.5D; Santen Pharmaceutical, Osaka, Japan) was placed in the ciliary sulcus due to intraoperative posterior capsule rupture. All the CARE guidelines were followed, and the CARE Checklist has been provided as online supplementary material (see www.karger.com/doi/10.1159/000527750 for all online suppl. material).

From the day after surgery, the patient had uveitis of the right eye and blurred vision, and the IOP in the right eye was elevated (46 mm Hg). After treatment with betamethasone ophthalmic solution, dorzolamide hydrochloride/timolol maleate ophthalmic solution, and oral acetazolamide sodium, IOP was reduced but uveitis did not improve. The patient's blurred vision continued; therefore, the patient was referred to our hospital 2 weeks after surgery. At the first visit to our hospital, uncorrected visual acuity (UCVA) was 10/20, best-corrected visual acuity (BCVA) 20/20, myopia of −1.0 D was observed, and IOP in the right eye was 15.0 mm Hg with glaucoma instillation. The aqueous flare value (FM-700; Kowa Co., Aichi, Japan) was 131.1 ± 30.3 pc/ms, and the corneal endothelial cell density (PARACENTRAL®; NIDEK, Aichi, Japan) was 2,985 cells/mm^2. The IOL haptics were fixed between the iris and the anterior capsule (Fig. 1a). Irregularly shaped pupils, due to posterior synechia and pigmentation on the IOL surface, were also observed (Fig. 1b). In the Scheimpflug image using the Pentacam® (Nikon Solutions, Tokyo, Japan), the anterior capsule was photographed as areas with strong scattered light (arrow), an IOL on the anterior capsule was observed (Fig. 1c, d), and the anterior chamber depth was 2.92 mm. Gonioscopy revealed pigment deposition on a 360° trabecular meshwork. The axial length of the right eye (OA-2000; TOMEY, Aichi, Japan) was 22.89 mm. A diagnosis of pigment dispersion syndrome and elevated IOP due to sulcus IOL placement was made. Two weeks later, we planned intrascleral IOL fixation surgery using the already inserted IOL to reposition the IOL under the anterior capsule.

For preoperative anesthesia, 1.0 mL of sub-Tenon's anesthesia of 2% xylocaine (Sandoz K. K., Tokyo, Japan) was administered. The surgical machine used was the CONSTELLATION® Vision System (Alcon Laboratories, Fort Worth, TX, USA). After making a 2.4-mm scleral tunnel incision, two ports using 25-G instruments were placed for vitrectomy. The continuous curvilinear capsulorhexis (CCC) was enlarged using a vitreous cutter and the anterior vitreous

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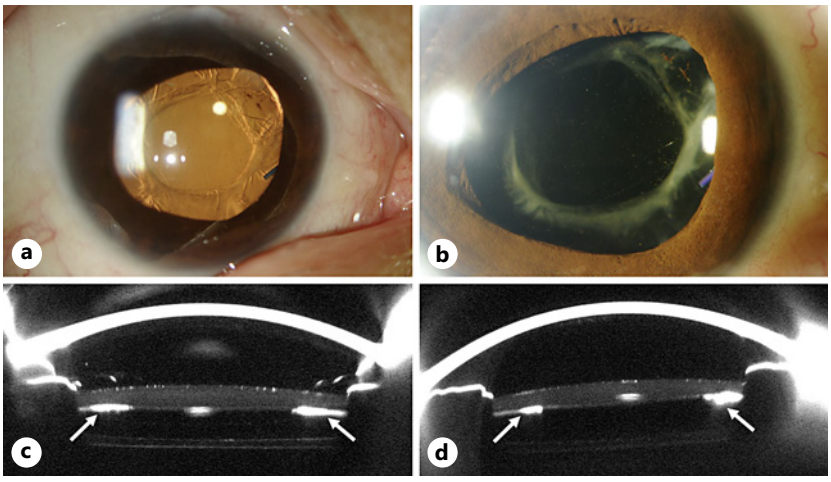

Fig. 1. Preoperative findings. **a** Both the optics and support of the IOL are fixed under the iris and anterior capsule. **b** Pupil irregularities due to post-iris adhesions and many pigment deposits on the IOL surface are observed. Scheimpflug images obtained using the Pentacam® (Nikon Solutions) (**c**, 90° direction; **d**, 180° direction) confirmed that the IOL optics were fixed on the anterior capsule (arrow).

was resected (Fig. 2a). Purified sodium hyaluronate and chondroitin sulfate sodium (Shellgan®; Seikagaku Corp., Tokyo, Japan) were filled in the anterior chamber, and then one sodium hyaluronate 0.85 ophthalmic viscoelastic preparation (Seikagaku Corp.) was injected under the iris. Using a hook, the NX-70S IOL inserted under the iris was dislocated into the anterior chamber (Fig. 2b). One haptic was removed from the scleral wound to prevent it from falling into the vitreous cavity. The double-needle method described by Yamane et al. [5] was used for intrascleral IOL fixation. Angle sclerotomy was performed using a 30-G thin-wall needle (TSK ultra-thin wall needle; Tochigi Seiko, Tochigi, Japan) 2 mm from the limbs, followed by 180° from the first sclerotomy. The leading haptic was inserted into the lumen of the needle using anterior capsule forceps (Fig. 2c). Next, the trailing haptic was inserted into the lumen of another needle, and the IOL was inserted under the anterior capsule. Both haptics were pulled out of the conjunctiva together with 30-G needles, and the ends of the haptics were cauterized to make a flange with a diameter of 0.3 mm using an ophthalmic cautery device (Accu-Temp Cautery; Beaver Visitec, Waltham, MA, USA) (Fig. 2d). The flange was pushed back and fixed to the scleral tunnels.

One week after surgery, the refractive error (−1.0 D) was corrected and the UCVA of the right eye was 20/20. IOP in the right eye was 15 mm Hg (without glaucoma instillation). The aqueous flare value was 51.9 ± 3.4 pc/ms and decreased from the preoperative value. The corneal endothelial cell density was 2,525 cells/mm^2. The anterior chamber inflammation and IOL surface pigmentation improved (Fig. 3a), and the pupil became a regular circle (Fig. 3b). The Scheimpflug images using the Pentacam® (Nikon Solutions) showed the IOL located behind the anterior capsule (arrow in Fig. 3c, d) and an anterior chamber depth of 3.88 mm.

Discussion

The 7-mm optic diameter IOLs used in Japan include X-70S and NX-70S (Eternity®, Eternity Fine Natural®; Santen Pharmaceutical). These IOLs are hydrophobic and comprised of 4% water, hydroxyethyl methacrylate, polyethylene glycol phenyl ether acrylate, and

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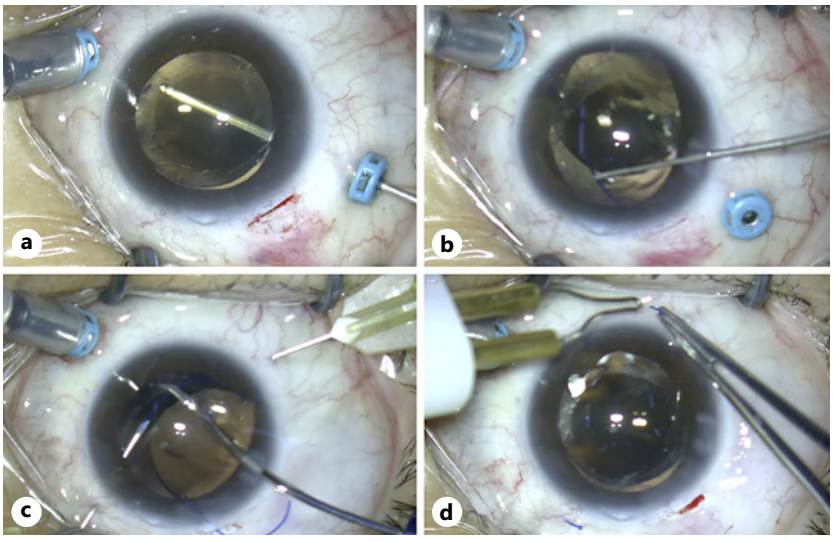

Fig. 2. Intraoperative findings. **a** The anterior capsule incision was enlarged using a 25-G vitreous cutter, and the anterior vitreous was resected. **b** NX-70 inserted under the iris was dislocated into the anterior chamber using a hook. **c** A 30-G thin-walled needle was inserted 2 mm from the limbs, and the anterior support was inserted into the lumen of the needle with an anterior capsule. **d** Both supports were pulled out of the eye together with a 30-G needle, a flange with a diameter of 0.3 mm was prepared at the tip of the support, and the flange was pushed back and fixed to the sclera.

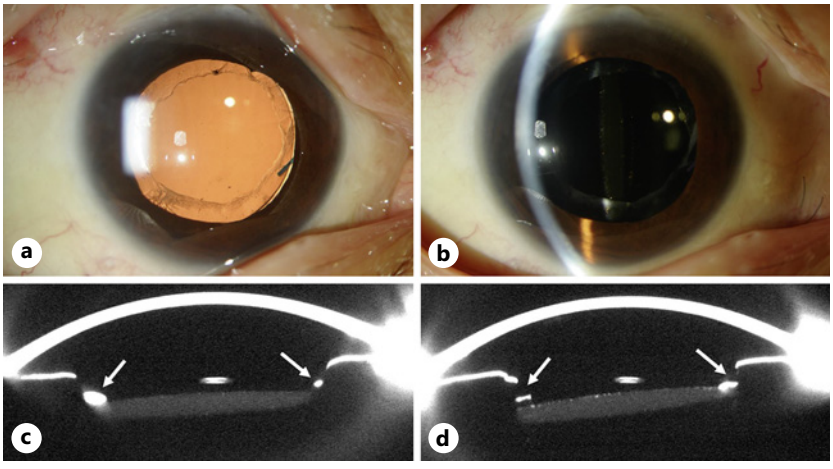

Fig. 3. Postoperative findings. **a** Inflammation in the anterior chamber and pigmentation on the IOL surface improved. **b** After the operation, the pupil became a perfect circle. In the Scheimpflug image by Pentacum® (Nikon Solutions) (**c**, 90° direction; **d**, 180° direction), the IOL was positioned posterior to the anterior capsule (arrow).

styrene cross-linked with ethylene glycol dimethacrylate [6]. X-70S is a nontinted IOL and NX-70S is a yellow-tinted IOL. The shape of the optics is a square-edge shape with an optic diameter of 7.0 mm and a total length of 13.5 mm. A large optic diameter IOL is frequently used for combined cataract and vitrectomy surgery because of its good visibility in vitrectomy [3, 4]; it is also used for intrascleral IOL fixation [5].

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In this case, NX-70S was placed in the sulcus because the posterior capsule was ruptured despite a complete CCC during the first right eye cataract surgery. Because of the short axial length and PACS, malignant glaucoma could be a differential diagnosis; however, in this case, the iris was almost horizontal and not elevated in Figure 1c and d, the anterior chamber depth was 2.92 mm, and the trabecular meshwork was observed in 360° using gonioscopy, making malignant glaucoma unlikely. The uveitis and high IOP, irregularly shaped pupil and pigmentation on the IOL surface, and anterior chamber angle were observed; as such, it was diagnosed as pigment dispersion syndrome due to sulcus IOL placement.

The thickness of the implanted IOL, the IOL total diameter, the implantation technique, and the angulation of the IOL haptics have been reported as relevant factors for the occurrence of pigment dispersion syndrome [7]. When a plate-haptic IOL [8] and a sharp-edge IOL [9] are placed in the ciliary sulcus, pigment dispersion syndrome is likely to occur and it is thought that the main cause is the contact between the IOL optics and the posterior iris. Because the shape of the haptics of the single-piece IOL is planar, large, and thick, sulcus placement causes pigment dispersion syndrome because of friction with the iris [10, 11]. When fixing three-piece 6-mm IOLs in the sulcus, the entire IOL is placed in the ciliary sulcus, or IOL optic capture methods devised by Gimbel and DeBroff [12] may be used. Optic capture is an effective surgical procedure in which the haptics are placed in the ciliary sulcus and the optic is captured through the anterior CCC. Long-term stability has been reported with this method. Furthermore, Chang et al. [2] reported that IOL frequency adjustment was not necessary when optic capture was performed. Brunin et al. [13] found that patients with optic capture had fewer complications such as postoperative IOL deviation and cystoid macular edema than those without optic capture. In this case, a 7-mm IOL was placed in the ciliary sulcus and optic capture was not performed. Gimbel and DeBroff [12] suggested that the diameter of the CCC must be 1–2 mm smaller than that of the IOL optics when performing optic capture. Since the complete CCC remained in this case, there was also the potential to perform IOL optic capture; however, expanding the CCC to an appropriate size for 7-mm optic IOL capture was difficult, and there was the possibility of a fragile Zinn's zonule. Therefore, intrascleral IOL fixation was selected because it can reliably correct the position of the IOL and has a good long-term prognosis. Since we had obtained information on the inserted IOL power, we recalculated the IOL power before surgery and obtained assurance that the ideal postoperative refraction value could be obtained by reusing the inserted IOL for intrascleral fixation. Intrascleral fixation using the IOL placed in the sulcus corrected myopia (−1.0 D) and improved UCVA. The IOL surface pigmentation was decreased, IOP was reduced, and glaucoma treatment became unnecessary postoperatively. The reduction rate of corneal endothelial cell density was 15.4%, which was higher than the previously reported reduction rate in normal cataract cases [14]. However, the anterior chamber depth became deeper than before the surgery, the aqueous flare value was improved, and the uveitis disappeared. For intrascleral IOL fixation, surgical techniques have been established in recent years, and good postoperative results have been reported [15]. Intrascleral IOL fixation has also been effective in cases of inflammation, such as in this case.

The distance between the sulcus edges of the ciliary groove is estimated to be approximately 11.0–12.5 mm. Therefore, placement of the haptics of an IOL with an adequate diameter of 12.5 mm or more in the ciliary sulcus would provide stable haptic fixation by generating outward tension [11]. The total length of the NX-70S was 13.5 mm, and placement in the sulcus is possible even in cases of posterior capsule rupture. However, unexpected pigment dispersion syndrome occurred in this case. Because the patient had a slightly shorter axial length of 22.89 mm and PACS, it can be inferred that pigment dispersion syndrome occurred due to friction between the iris and the shape of the optic edge with a large optic diameter of 7 mm.

In cases of posterior capsule rupture with short axial length and PACS, placement of an IOL with a 7-mm optic diameter in the sulcus may cause pigment dispersion syndrome. Therefore, using a 7-mm optic diameter IOL should be avoided or intrascleral IOL fixation should be selected as the surgical technique.

Statement of Ethics

This report was approved by the Institutional Review Board of Dokkyo Medical University (No. DMUH-CR2022-002). Written informed consent was obtained from the patient for publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Mayumi Nagata conceived the idea of the report and drafted the original manuscript. Hiroyuki Matsushima contributed to the interpretation of the results. Tadashi Senoo supervised the conduct of this study. All authors reviewed the manuscript draft and critically revised the intellectual content of the manuscript. All authors approved the final version of the manuscript to be published.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of the patient.

References

1 Micheli T, Cheung LM, Sharma S, Assaad NN, Guzowski M, Francis IC, et al. Acute haptic-induced pigmentary glaucoma with an AcrySof intraocular lens. J Cataract Refract Surg. 2002 Oct;28(10):1869–72.
2 Chang DF, Masket S, Miller KM, Braga-Mele R, Little BC, Mamalis N, et al. Complications of sulcus placement of single-piece acrylic intraocular lenses: recommendations for backup IOL implantation following posterior capsule rupture. J Cataract Refract Surg. 2009 Aug;35(8):1445–58.
3 Kabata Y, Takahashi G, Tsuneoka H. Neodymium: yttrium-aluminum garnet capsulotomy rates after combined cataract surgery with implantation of a 4% water content hydrophobic acrylic intraocular lens and vitrectomy. Clin Ophthalmol. 2013 Nov;7:2215–8.
4 Watanabe A, Shibata T, Ozaki M, Okano K, Kozaki K, Tsuneoka H. Change in anterior chamber depth following combined pars plana vitrectomy, phacoemulsification, and intraocular lens implantation using different types of intraocular lenses. Jpn J Ophthalmol. 2010 Sep;54(5):383–6.

5 Yamane S, Sato S, Maruyama-Inoue M, Kadonosono K. Flanged intrascleral intraocular lens fixation with double-needle technique. Ophthalmology. 2017 Aug;124(8):1136–42.
6 Ollerton A, Werner L, Fuller SR, Kavoussi SC, McIntyre SJ, Mamalis N. Evaluation of a new single-piece 4% water content hydrophobic acrylic intraocular lens in the rabbit model. J Cataract Refract Surg. 2012 Oct;38(10):1827–32.
7 Ernest PH, Lavery KT, Hazariwala K. Occurrence of pigment precipitates after small incision cataract surgery. J Cataract Refract Surg. 1998 Jan;24(1):91–7.
8 Apple DJ, Reidy JJ, Googe JM, Mamalis N, Novak LC, Loftfield DK. A comparison of ciliary sulcus and capsular bag fixation of posterior chamber intraocular lenses. J Am Intraocul Implant Soc. 1985 Jan;11(1):44–63.
9 Ollerton A, Werner L, Strenk S, Strenk L, Leishman L, Bodnar Z, et al. Pathologic comparison of asymmetric or sulcus fixation of 3-piece intraocular lenses with square versus round anterior optic edges. Ophthalmology. 2013 Aug;120(8):1580–7.
10 Kohnen T, Kook D. Solving intraocular lens-related pigment dispersion syndrome with repositioning of primary sulcus implanted single-piece IOL in the capsular bag. J Cataract Refract Surg. 2009 Aug;35(8):1459–63.
11 Mehta R, Aref A. Intraocular lens implantation in the ciliary sulcus: challenges and risks. Clin Ophthalmol. 2019 Nov;13:2317–23.
12 Gimbel HV, DeBroff BM. Intraocular lens optic capture. J Cataract Refract Surg. 2004 Jan;30(1):200–6.
13 Brunin G, Sajjad A, Kim EJ, de Oca IM, Weikert MP, Wang L, et al. Secondary intraocular lens implantation: complication rates, visual acuity, and refractive outcomes. J Cataract Refract Surg. 2017 Mar;43(3):369–76.
14 Storr-Paulsen A, Norregaard JC, Ahmed S, Storr-Paulsen T, Pedersen TH. Endothelial cell damage after cataract surgery: divide-and-conquer versus phaco-chop technique. J Cataract Refract Surg. 2008 Jun;34(6):996–1000.
15 Sül S, Kaderli A, Karalezli A, Kaya C. Comparison of decentration, tilt and lenticular astigmatism of intraocular lens between sutured and sutureless scleral fixation techniques. J Fr Ophtalmol. 2021 Oct;44(8):1174–9.