JNMS Journal of Nippon Medical School https://www.nms.ac.jp/sh/jnms/

Original

Zonular Apparatus Capsular Bag Insufficiency with Spontaneous Posterior Capsule Rupture

Kohei Miyata, Natsuko Maeda and Shinichiro Kobayakawa

Department of Ophthalmology, Nippon Medical School Musashikosugi Hospital, Kanagawa, Japan

Background: Zonular apparatus capsular bag (ZACB) insufficiency causes late postoperative spontaneous in-the-bag intraocular lens (IOL) dislocation, a serious complication of cataract surgery. Spontaneous posterior capsule rupture (SPCR) with IOL dislocation is a rare complication. This study reports and discusses clinical features and outcomes of ZACB insufficiency with SPCR.

Methods: We retrospectively reviewed 7 cases of SPCR that developed after cataract surgery at Nippon Medical School Musashi Kosugi Hospital between March 2021 and February 2025. Clinical records and surgical videos were examined to collect data on patient age, sex, associated systemic and ocular conditions, medications, dates of IOL implantation and explantation, signs and symptoms prompting explantation, and surgical outcomes. The stage of capsular rupture and location of intraocular lens dislocation were classified on the basis of intraoperative findings.

Results: The anterior capsule rim and zonule were intact in 5 SPCR cases, with the exchanged IOL fixated in the sulcus. Two cases of SPCR exhibited both anterior and posterior capsule dislocation requiring intrascleral IOL fixation. The average age of the patients was 52 years (range: 29–83 years; 6 men, 1 woman), and 5 (4 men, 1 woman) had atopic dermatitis. Time since the initial cataract surgery ranged from 10 to 20 years (mean, 13.8 years).

Conclusions: Most SPCR cases were associated with atopic dermatitis, with minor trauma possibly contributing to ZACB insufficiency. Capsule morphology was preserved in most SPCR cases, with the exception of posterior capsule rupture.

(J Nippon Med Sch 2026; 93 (1): 12–16. https://doi.org/10.1272/jnms.JNMS.2026_93-107)

Keywords: dislocation, intraocular lens, posterior capsule, rupture, spontaneous

Introduction

Late postoperative spontaneous in-the-bag intraocular lens (IOL) dislocation is a serious complication of cataract surgery. Several articles have reported a recent increasing trend in late in-the-bag IOL dislocation. Cumulative incidence was 0.5% to 3%, the average interval from cataract surgery to occurrence was 6 to 12 years, and mean patient age was 65 to 85 years[1].

IOL dislocations are classified according to the position of the IOL as in-the-bag or out-of-the-bag. For in-the-bag dislocation, the IOL is inside the capsule and the whole IOL-capsule complex is dislocated. Out-of-the-bag IOL dislocation refers to displacement of an intraocular lens that occurs outside the capsular bag, which usually happens during the early postoperative period and is often associated with rupture of the posterior capsule during surgery. In contrast, in-the-bag IOL dislocation usually occurs much later after cataract surgery, because of zonular weakening and loosening, and is often associated with contraction of the anterior lens capsule. In addition, in-the-bag IOL dislocation is best understood as a manifestation of the zonular apparatus and capsular bag

Correspondence to Kohei Miyata, k-miyata@nms.ac.jp
https://doi.org/10.1272/jnms.JNMS.2026_93-107
Received: May 6, 2025; Accepted: August 22, 2025

(ZACB) insufficiency.

Posterior capsule rupture is one of the most common intraoperative complications of cataract surgery and can also result from postoperative trauma[2–4]. Spontaneous posterior capsule rupture (SPCR) after cataract surgery and IOL implantation, resulting in IOL dislocation, is rare. In cases of SPCR, IOL dislocation is classified as out-of-the-bag when the IOL is fully dislocated into and resides within the vitreous cavity. However, there are also cases that are classified as in-the-bag, ie, when a portion of the IOL remains partially retained within the residual capsular bag. Our present literature review revealed that fewer than 30 cases have been reported[5–9]. Thus, because of the limited number of documented cases, the exact mechanism underlying SPCR remains unclear. Culp et al.[8] reported the clinical and histopathological findings of dead bag syndrome, including eight cases of SPCR. In contrast to these previously reported cases, the present SPCR cases had distinct features, including lens epithelial cells (LECs) on the inner surface of the anterior capsule and Soemmerring's ring in some cases. However, in other cases, the anterior capsule remained intact, with preservation of the ZACB.

The aim of the present study was to report and discuss the clinical features and outcomes of 7 cases of ZACB insufficiency associated with SPCR. Furthermore, we staged these cases to improve understanding of the pathological progression of SPCR and determine appropriate surgical management.

Materials and Methods

This retrospective review analyzed 7 cases of SPCR after cataract surgery at Nippon Medical School Musashi Kosugi Hospital between March 2021 and February 2025. SPCR was clinically diagnosed in cases of acute visual impairment due to intraocular lens dislocation for which spontaneous rupture of the posterior capsule was identified as the underlying cause. Of the 7 SPCR patients analyzed, none had a history of Nd:YAG laser capsulotomy, pars plana vitrectomy, trauma, or any other identifiable direct causative factor. A case summary that included patient age, sex, associated systemic and ocular conditions, medications, dates of IOL implantation and explantation, signs and symptoms prompting explantation, and surgical outcomes was compiled. The diagnosis of atopic dermatitis was confirmed by reviewing medical records documenting the dermatologist diagnosis. All surgeries were performed by the same surgeon (S.K.). The stage of capsular rupture and location of the intraocular lens dislocation were classified based on intraoperative findings. No standardized grading system was used to assess the severity of ZACB insufficiency during surgery.

All the participants received an explanation of the study and provided informed consent for participation. The study adhered to the tenets of the Declaration of Helsinki, and the study protocol was approved by the Institutional Review Central Ethics Committee of the Nippon Medical School Foundation on April 22, 2025 (approval number: 2024-1583).

Results

Table 1 shows the patients' characteristics, clinical diagnoses, and surgical treatment. The mean age of the patients was 52.4 years (range: 33–64 years), and there were 6 males and 1 female. SPCR occurred at an average of 13.8 years (range: 8–20 years) after the initial cataract surgery, and 5 of the 7 patients had atopic dermatitis.

At the time SPCR was confirmed, 6 cases had a 1-piece acrylic IOL, while 1 case had a 1-piece polymethyl methacrylate (PMMA) IOL. The IOL position at the time of explantation was in the pupil area in 4 cases and in the vitreous in 3 cases. Soemmerring's ring was present in 3 cases, a small ring was present in 1 case, and no ring was present in 3 cases.

Peripheral anterior capsule remnants were identified in 5 cases, and sulcus fixation was performed as the initial exchange procedure. In the remaining 2 cases, for which the peripheral anterior capsule was absent, scleral fixation was chosen as the initial exchange procedure. Cases 1 and 7 required a second surgery. In Case 1, sulcus fixation was performed as the initial exchange procedure. However, at 1 year and 3 months, the patient developed retinal detachment, which necessitated a second surgery for management of IOL subluxation. In Case 7, although sulcus fixation was also initially performed, IOL subluxation recurred 1 month later, thereby requiring intrascleral fixation as the second procedure.

Discussion

Previous reports of SPCR have documented 20 male cases and only 2 female cases[5–9]. A study by Lee et al.[9] reported that 4 of 8 patients exhibited habitual eye rubbing behavior. Similarly, in our study, most patients were male and many had a history of atopic dermatitis, which is consistent with previous reports.

Regarding the mechanism of atopic cataract, major basic protein, which is derived from eosinophil granules in the aqueous humor, damages the LECs. This leads to re-

Table 1 Clinical characteristics of the present cases

Case	1	2	3	4	5	6	7
Age (years)	50	83	29	56	57	45	47
Sex	M	M	M	M	M	M	F
Laterality	R	L	R	R	L	R	L
Race	Asian	Asian	Asian	Asian	Asian	Asian	Asian
Length of explantation (years)	8	Unknown	10	14	8	20	23
IOL type	1P Acryl	1P Acryl	1P Acryl	1P Acryl	1P Acryl	1P PMMA	1P Acryl
Ocular comorbidity	None	None	None	None	None	None	None
History of intraoperative capsular rupture	None	None	None	None	None	None	None
History of Nd:YAG laser capsulotomy	None	None	None	None	None	None	None
History of pars plana vitrectomy	None	None	None	None	None	None	None
Axial length (mm)	25.33	23.04	24.77	26.36	25.39	22.65	26.37
General comorbidity	Atopy	None	Atopy	None	Atopy	Atopy	Atopy
IOL position at explantation	Vitreous	Vitreous	Pupil area	Pupil area	Pupil area	Pupil area	Vitreous
Expected Soemmerring's ring	+	None	None	None	+Little	+	+
Initial explantation procedure	Sulcus fixation	Sulcus fixation	Sulcus fixation	Sulcus fixation	Scleral fixation	Scleral fixation	Sulcus fixation
Exchange IOL type	3P NX Monofocal	1P ZMA Multifocal	3P NX Monofocal	3P NX Monofocal	3P NX Monofocal	3P NX Monofocal	3P NX Monofocal
Results after explantation exchange	Retinal detachment						Scleral fixation

duced cellular activity and development of atopic cataracts. Because of the decreased activity of the LECs, adhesion between the IOL and the capsular bag may be impaired after cataract surgery[10]. It has been reported that adhesion between the capsular bag and IOL tends to be poor in patients with atopic dermatitis, which makes the IOL more prone to movement. This is associated with toric IOL misalignment[11].

Patients with atopic dermatitis often rub their faces. Although the mechanism of SPCR remains unclear, excessive eye rubbing may cause the IOL to rotate, shift, or become unstable within the capsular bag. These changes could potentially lead to posterior capsule damage from the sharp edge of the IOL haptic. In patients with atopic dermatitis, persistent eye rubbing can result in posterior capsule rupture and IOL dislocation even years after cataract surgery. This highlights the importance of postoperative lifestyle guidance to prevent such complications.

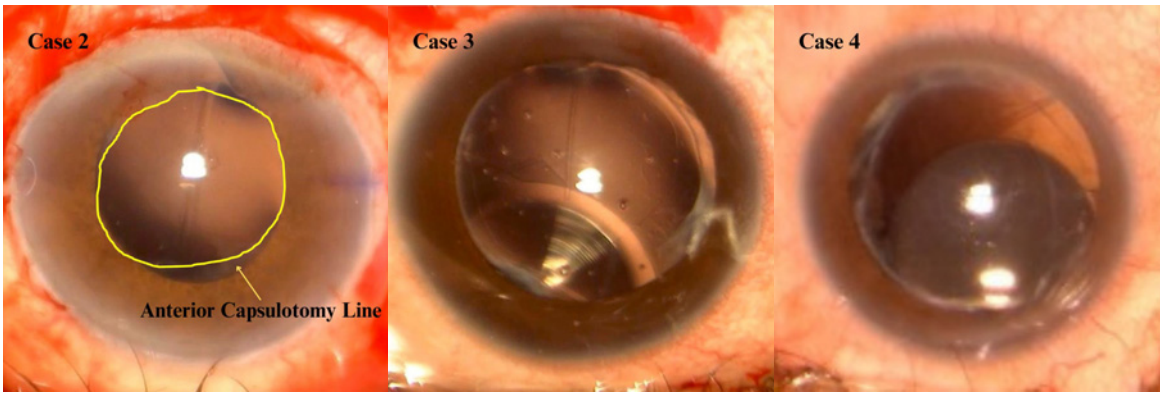
In the present patients, IOL position at the time of SPCR was unclear: 4 had an IOL in the pupil area and 3 in the vitreous. Sulcus fixation was performed during the initial exchange surgery. However, in 2 of 5 cases transition to intrascleral fixation was soon required.

To better understand SPCR cases, as illustrated in **Figure 1**, we classified cases into three stages based on the condition of the ZACB. In Stage 1, posterior capsule rupture was present, but the ZACB remained intact. Sulcus fixation was performed during IOL exchange, and the IOL remained stable in the sulcus position. Cases 2, 3, and 4 were classified as Stage 1; the patients exhibited a ruptured posterior capsule, with a preserved ZACB. The continuous curvilinear capsulorhexis (CCC) remained intact. In Cases 2 and 3, the IOL was not visible during the outpatient slit-lamp examination but was identified behind the iris intraoperatively. In Case 4, IOL dislocation was already evident during an outpatient examination. In Cases 2–4, the IOL was considered to be partially dislocated out-of-the-bag. There was dislocation of the IOL into the vitreous cavity, prompting a 27 G pars plana vitrectomy for IOL removal and implantation. Using a finesse loop and micro forceps, the IOL was retrieved and then positioned on the iris, where it was bisected and explanted. As there was no zonular dehiscence and the CCC was intact, a 3-piece IOL was implanted into the capsular bag.

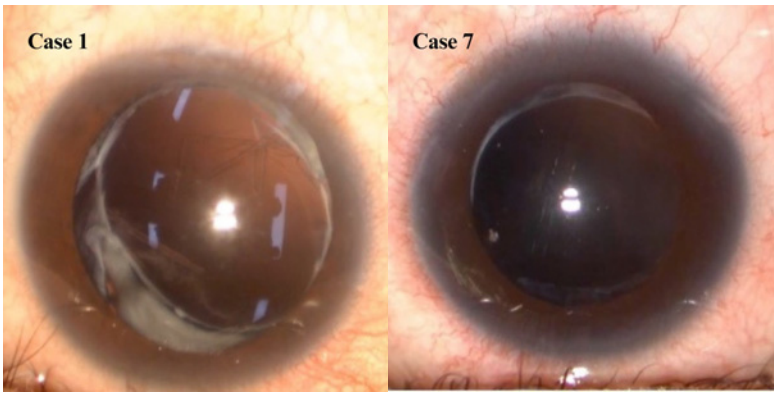
Stage 2 is a transitional stage. The posterior capsule rupture and ZACB were initially intact. However, a second IOL subluxation soon occurred and required scleral fixation. Cases 1 and 7 were classified as Stage 2, as the IOL was dislocated out-of-the-bag and within the vitreous cavity. Stage 2 represents a transitional phase marked by a second IOL subluxation, despite the ZACB and posterior capsule initially being intact. As a result, scleral fixation is necessary.

In Stage 3, SPCR occurred with a completely disrupted

Stage 1: SPCR and ZACB are intact.



Stage 2: SPCR and ZACB are initially intact. However, a second IOL subluxation soon occurs.



Stage 3: SPCR occurs and the ZACB is completely disrupted.

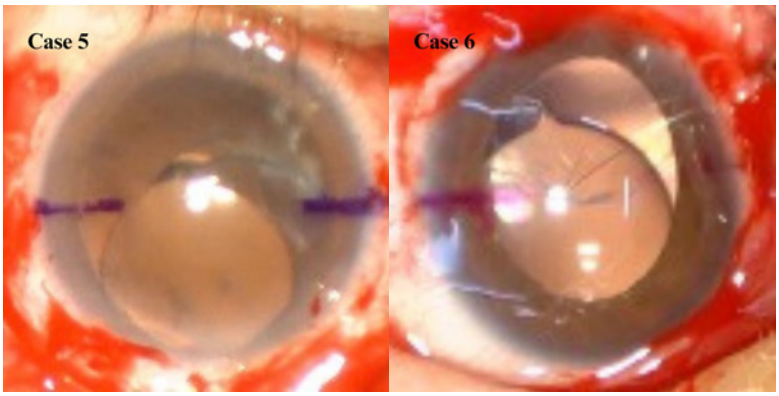


Figure 1 Staging of SPCR cases based on the condition of the ZACB

ZACB, necessitating scleral fixation. Cases 5 and 6 were classified as Stage 3. In these patients, part of the IOL was dislocated out-of-the-bag through a rupture in the posterior capsule. Unlike the typical in-the-bag IOL dislocation, where the entire IOL-capsule complex is displaced from ZACB insufficiency, these cases exhibited partial subluxation of the IOL through a localized posterior capsular rupture.

It is unclear when a case will transition from Stage 1 to Stage 2. Thus, surgeons are more likely to choose sulcus fixation initially, as its early outcomes are generally better than those for scleral fixation. In such cases, all ruptured posterior capsules are transparent.

Previous studies reported cases of "dead bag syndrome"[8]. In these cases, the capsular bag remains clear for many years postoperatively, without any fibrotic changes or proliferative material inside. However, in SPCR cases the capsular bag becomes diaphanous and floppy, leading to inability to support the IOL. As LECs are rarely observed on the inner surface of the capsule, no Soemmerring's ring is present. In our SPCR cases, LECs were observed on the inner surface of the anterior capsule. Furthermore, the posterior capsule remained clear, similar to dead bag syndrome. However, Soemmer-

ring's ring was noted in our cases.

ZACB insufficiency encompasses various forms of in-the-bag IOL subluxation and dislocation[12]. Although SPCR and dead bag syndrome are considered types of ZACB insufficiency, they significantly differ in their pathophysiological mechanisms. In our 2 SPCR cases, the anterior capsule rim and zonule were intact at the time of the IOL exchange. Nevertheless, the capsular complex became dislocated shortly afterward. Although LECs were not absent in our cases, their functional activity was diminished. This may explain the transparency of the posterior capsule observed in SPCR, which resembles that seen in dead bag syndrome. A similar mechanism has been proposed in atopic cataract, wherein major basic proteins derived from eosinophilic granules in the aqueous humor damage lens LECs, leading to decreased cellular activity. We speculate that a similar pathophysiological process may have contributed to SPCR in our patients with atopic dermatitis.

In summary, SPCR is a rare, spontaneous late complication that arises approximately 10 years after cataract surgery. It tends to be more common in men and in persons with atopic dermatitis. Consideration of the stages of SPCR progression may assist in determining the appropriate surgical approach.

Author Contributions: SK designed the concept of this study. NM analyzed the patient data. NM and KM interpreted the patient data. KM drafted the manuscript. SK supervised. All authors made substantial contributions to this work. All authors have reviewed and approved the final manuscript.

Acknowledgments: We gratefully acknowledge the work of our ophthalmic technicians.

Funding: No funding was received for this study.

Conflict of Interest: None declared.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: The authors declare that no generative AI or AI-assisted technologies were used in the writing, editing, or figure preparation of this manuscript.

References

1. Kristianslund O, Dalby M, Drolsum L. Late in-the-bag intraocular lens dislocation. J Cataract Refract Surg. 2021;47:942–54.
2. Zaidi FH, Corbett MC, Burton BJ, Bloom PA. Raising the benchmark for the 21st century--the 1000 cataract operations audit and survey: outcomes, consultant-supervised training and sourcing NHS choice. Br J Ophthalmol. 2007;91:731–6.
3. Grewal DS, Jain R, Brar GS, Grewal SP. Posterior capsule rupture following closed globe injury: Scheimpflug imaging, pathogenesis, and management. Eur J Ophthalmol. 2008;18:453–5.
4. Mansour AM, Jaroudi MO, Hamam RN, Maalouf FC. Isolated posterior capsular rupture following blunt head trauma. Clin Ophthalmol. 2014;8:2403–7.
5. Yehezkeli V, Wong JXH, Assia EI. Late spontaneous posterior capsule rupture after hydrophilic intraocular lens implantation. J Cataract Refract Surg. 2021;47:311–5.
6. Chen DA, Yassari N, Kiss S, Starr CE. Bilateral posterior capsule rupture and anterior vitreous prolapse from vigorous eye rubbing. Am J Ophthalmol Case Rep. 2022;26:101426.
7. Bassily R, Lencova A, Rajan MS. Bilateral rupture of the posterior capsule and intraocular lens dislocation from excessive eye rubbing. J Cataract Refract Surg. 2016;42:329–31.
8. Culp C, Qu P, Jones J, et al. Clinical and histopathological findings in the dead bag syndrome. J Cataract Refract Surg. 2022;48:177–84.
9. Lee S, Lee G, Park CY. Late spontaneous posterior capsule rupture with single-piece hydrophobic acrylic intraocular lens dislocation. Sci Rep. 2024;14:3368.
10. Yamamoto N. [Collaboration of Basic and Clinical Study in the Crystalline Lens and Cataract]. J Jpn Soc Cataract Res. 2008;20:12–9. Japanese.
11. Takagi M, Kojima T, Hasegawa A, et al. [Rotation of intraocular lens two years after initial cataract surgery in a case with atopic cataract]. IOL & RS: Jpn J cataract refractive surg. 2017;31:247–51. Japanese.
12. Darian-Smith E, Safran SG, Coroneo MT. Zonular and capsular bag disorders: a hypothetical perspective based on recent pathophysiological insights. J Cataract Refract Surg. 2023;49:207–12.