



Study of Anterior Capsular Contraction Following Cataract Surgery with Frequently Used Intraocular Lenses

Zhou Y*, Ding Y, Huang Y and Hou P

Department of Ophthalmology, People's Hospital of Bozhou City, China

Abstract

Anterior Capsular Contraction Syndrome (ACCS) was compared in this study with cataract patients whose eyes were implanted with one of two types of acrylic lenses frequently used.

Methods: The study included 125 eyes of 112 patients. All of them, phacoemulsification and Intraocular Lens (IOL) implantation were successfully performed. Each patient was operated on by the same surgeon, two types of IOLs were implantation during cataract surgery: CT ASPHINA 509M [Zeiss] (IOL A), the Akreos AO [Bausch & Lomb] (IOL B). Patients with intraoperative capsular tears and follow-up surveys less than one month were excluded. In these cases, we recorded the duration of postoperative follow-up, the presence of ACCS, along with the dimensions of the anterior capsule opening. A comparison of ACCS incidence was compared between the two lenses.

Results: Although the CT ASPHINA 509M group had more patients with ACCS risk factors ($P=0.009$), the ASPHINA 509M group had a significantly lower incidence of ACCS than the Akreos AO group ($P=0.032$).

Conclusion: Compared with the Akreos AO (IOL B), the CT ASPHINA 509M (IOL A) showed better anterior capsular stability and a lower incidence of ACCS.

Keywords: Anterior capsule contraction syndrome; Intraocular lens; Cataract surgery; Treatment outcome

Introduction

Combined with a posterior chamber Intraocular Lens (IOL) implant, the role of cataract surgery has expanded from one of visual restorative to refractive [1,2]. Anterior Capsular Contraction Syndrome (ACCS) refers to excessive capsular diameter contraction, which is a complication that cannot be ignored after cataract surgery. It occurs mainly due to the contact of residual lens epithelial cells with the Intraocular Lens (IOL) near the Continuous Curvilinear Capsulorhexis (CCC) [3]. The reduction of the equatorial diameter of the lens capsule and the narrowing of the CCC opening in operated eyes post-surgery are typical manifestations of CCC. The incidence of contraction most generally develops during the first three postoperative months, with a succeeding decline in development [4,5]. This complication can reduce the free optic zone. It may cause decentration of the IOL optic and tilt of the IOL.

Furthermore, it can be effective enough to disrupt the visual axis [6-8]. The IOL composition and design have been shown to contribute to the development of ACCS. For instance, it is well assured that acrylic IOLs caused less capsular shrinkage than silicone IOLs [9-11]. Additionally, the risk of ACCS has been associated with many risk factors, including Pseudoexfoliation (PXE) syndrome, retinitis pigmentosa, uveitis, diabetes, and history of retinal surgery [12-17].

Some studies only evaluated the material and edge type of the optics and the impact on ACCS [18,19]. We studied the incidence of ACCS after implantation of two generally used acrylic IOLs, the CT ASPHINA 509M (Carl Zeiss Inc, Germany) and the Akreos AO (Bausch & Lomb; USA). To our knowledge, this is the first study to compare the incidence of ACCS in these two common IOLs. Studying ACCS in these two lenses may illustrate the biomechanical factors that influence capsule phimosis. The study also aimed to determine which lenses, if any, should be considered for use in patients at risk for ACCS by including patients with or without associated risk factors.

Materials and Methods

This was a retrospective clinical study of patients that included 125 eyes of 112 patients from the

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*Correspondence:

Yongmou Zhou, Department of Ophthalmology, People's Hospital of Bozhou City, 616 Duzhong Road, Bozhou City, 236800, China, Tel: +86-189-5678-5187

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People's Hospital, Bozhou, China. Between June 2020 and June 2022, this study was authorized by the Institutional Review Board of Bozhou People's Hospital and complied with the purposes of the Declaration of Helsinki. The patient's informed consent was waived because it was a retrospective study. All data collected were excluded prior to analysis to meet the requirements of the People's Hospital, Bozhou Institutional Board's Institutional Review Committee. In all cases, the same surgeon performed standardized phacoemulsification from June 2020 and June 2022 using a 2.8 mm clear corneal incision and a 5 mm CCC, followed by phacoemulsification, cataract extraction, and IOL implantation. Two types of IOLs were implantation during cataract surgery: The CT ASPHINA 509M (IOL A) and the Akreos AO (IOL B). The CCC was measured and recorded during each procedure.

Inclusion criteria: Successful establishment of CCC and intracapsular fixation of IOL.

Exclusion criteria: 1. Intraoperative capsular tear; 2. Postoperative follow-up was less than 1 month; 3. The CCC diameter is less than 5 mm. Postoperative follow-up times the type of intraocular lens used, and the presence of ACCS were recorded. The capsulorhexis was observed by slit lamp and the diameter along the longitude of 90° and 180° was recorded. The size of the capsule opening was measured. The average of the two diameters is used to calculate the capsular area by the formula $A = \pi r^2$. When the measured diameter of any meridian is less than 3.5 mm and the corresponding opening area is less than 10 mm², it is considered that ACCS exists. There was a note on any PXE syndrome, past uveitis, retinitis pigmentosa, previous retinal surgery, or diabetes retinopathy (Table 1). Patients were also assessed for the presence of mature cataracts that were related to any ACCS.

IBM SPSS Statistics ver. 24.0 (IBM SPSS Statistics for Windows, Version 24.0., Armonk, NY, USA) software was used for statistical analysis. The Fischer's exact test and the Chi-squared test were used to explore any difference between ACCS occurrences and explore any differences in risk factor quantity between the two groups. The difference was statistically significant ($p \leq 0.05$).

Results

One hundred and twenty-five eyes of 112 patients were included in the study. Sixty-five (52%) were women and 60 (48%) were men. Sixty-three eyes had 509M lens implants and the remaining 60 eyes had Akreos AO lens implants. The average age of the patients at surgery was 68.2 ± 8.4 years for the 509M lens and 69.3 ± 9.6 years for the Akreos AO lens. There are no significant differences between neither male-to-female ratio ($p=0.825$) nor 509M lens group to Akreos AO lens group ratio ($p=0.265$) (Table 2).

ACCS was observed in 0 eyes with 509M lens and 4 eyes with Akreos AO lens, and the statistically difference was significant ($P=0.04$). At the last follow-up, the mean anterior capsular area of ACCS was 9.6 ± 2.6 mm², the median time to discover ACCS was 1.4 months (range 1-19 months), and only one case of ACCS (AO lens) required Nd:YAG laser capsular incision to improve visual acuity.

At least one risk factor for ACCS occurred in 9/63 (14.29%) eyes with IOL A and 8/62 (12.90%) eyes with IOL B. There was no significant difference ($P=0.442 \geq 0.05$). No cases of ACCS were detected in mature cataract patients.

Discussion

In this study, the incidence of ACCS was decreased in eyes

Table 1: Eyes with ACCS risk factors.

Risk factors	ACCS (-)		ACCS (+)	
	AO	509M	AO	509M
PXE syndrome	0	1	1	
Uveitis	1	0		
Retinitis pigmentosa				
History of retinal surgery	0	1		
Diabetic retinopathy	5	6	1	1
Total	6 ^b	8 ^b	12 ^a	1 ^a

(-) absence of ACCS, (+) presence of ACCS

^a Single eye with two risk factors: 1/63 (509M) and 2/62(AO)

^b Number of patients with at least one risk factor: 8/63 (509M) and 6/62(AO)

ACCS: Anterior Capsular Contraction Syndrome; PXE: Pseudoexfoliation

implanted with CT ASPHINA 509M IOL compared with those implanted with Akreos AO IOLS. This is largely due to differences in IOL composition and design [10,11,13], Although the two IOLs in this study have hydrophilic acrylic composition, their design is significantly different (Table 3).

To reduce the incidence of posterior cataracts, both lenses are designed with a 360° continuous edge. Although square-edged lenses decrease Posterior Capsule Opacification (PCO), they increase anterior capsule shrinkage [12]. Recently, Miyata et al. [10] concluded that a square edge is not a risk factor for ACCS. Based on this discrepancy, other distinctions were explored.

Choi et al. [20] concluded that anterior capsular stability may be affected by the number and position of haptics within the capsular bag. It is presumed that evenly supporting zonules contributes to anterior capsular stability. The meta-analysis showed that hydrophobic acrylates reduced the incidence of membrane turbidity compared with hydrophilic acrylates [21]. There may have been differences in the biomechanical properties of these lenses that may have contributed to the higher rate of ACCS in the AO lens in our study. Several studies showed that hydrophobic acrylates reduced the incidence of membrane turbidity compared with hydrophilic acrylates [22,23]. The 509M IOL significantly reduced anterior capsule retraction and ACO development compared to the Acrys of SA60AT. It has a better performance when it comes to preventing ACCS [24]. This good performance of TECNIS was also confirmed in our study.

It was shown that using various diameters to represent different sized capsules. The CT ASPHINA 509M applied a greater force than the Akreos AO. In prior studies, capsule tension imbalances were believed to be responsible for ACCS pathogenesis. An outward force provided by lens haptics is hypothesized to provide increased resistance to the contraction forces of ACCS, which stabilizes the bag and reduces zonular tension. Cochener et al. [15] hypothesized that the silicone lens' increased flexibility contributed to the higher rate of ACCS compared with other lenses. In addition, zonular friability in PXE syndrome was suggested to contribute to ACCS risk [25].

There was no relation between cohort risk factors and the low incidence of CT ASPHINA 509M ACCS in our study. It was noted by the surgeon during this study that AO IOLs had a greater risk of ACCS. Therefore, the surgeon chose the CT ASPHINA 509M IOL for patients with ACCS risk factors as well. According to the "Results" section, 8/62 (12.90%) eyes with AO IOL had at least one risk factor, whereas 9/63 (14.29%) eyes with 509M IOL had at least one risk

Table 2: Patient demographics and ACCS incidence.

Group	Eyes (n)	Average age (years), mean \pm SD	Male (n)/Female (n)	Disease course (years)	Average follow-up (months), median statistic	ACCS cases (n)	ACCS incidence (%)
CT ASPHINA 509M lens	63	68.2 \pm 8.4	30/33	8.5 \pm 7.3	4.8 (1-33.4)	0	0
AO lens	62	69.3 \pm 9.6	30/32	9.2 \pm 6.6	4.5 (1-33.1)	4	6.45
p-value or χ^2	0.916*	0.991*	0.825*	0.847*	0.564*	0.04	

ACCS: Anterior Capsular Contraction Syndrome; *One-way ANOVA test

Table 3: Lens specifications.

Characteristic	CT ASPHINA 509M (Zeiss Inc)	Akreos AO (Bausch+Lomb Inc)
Material	1-piece hydrophobic acrylic (Hydrophilicity with hydrophobic surface Acrylic (25%))	1-piece hydrophilic acrylic
Overall length (mm)	11	10.5 to 11.0
Optic Diameter (mm)	6	6
Index Refraction	1.46	1.54
Abbe number	60	41
Optic design	Biconvex	Biconvex
Optic edge	360° square edge	360° square edge
Haptics design	plate haptic	four-loop plate
Haptics Position with	Offset, 4-point	Offset, 4-point
Haptics respect to optic	fixation	fixation

factor. In the 9 eyes with at least one risk factor that received the 509M lens, none of them developed ACCS.

Conclusion

This study demonstrates that using the CT ASPHINA 509M lens may lead to a lower risk of developing ACCS as compared with the Akreos AO lens, a result partly explained by the CT ASPHINA 509M's increased mechanical rigidity. CT ASPHINA 509M IOL should be considered for patients at risk for capsular contraction after cataract extraction.

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