Morphological characteristics of the subfoveal choroid and their association with visual acuity in postoperative patients with unilateral congenital cataracts

Yue Zhou[1], Jinghui Wang[1], Ling Jin[1], Wan Chen[1], Qiwei Wang[1], Hui Chen[1], Jingjing Chen[1], Zhouyue Li[1], Zhuoling Lin[1], Xiaoyan Li[1], Jing Li[1], Haotian Lin[1,2#], Duoru Lin[1#], Weirong Chen[1#]

[1]State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangdong Provincial Key Laboratory of Ophthalmology and Visual Science, Guangzhou, China; [2]Center for Precision Medicine, Sun Yat-sen University, Guangzhou, China

Contributions: (I) Conception and design: Y Zhou; (II) Administrative support: Weirong Chen, D Lin, H Lin; (III) Provision of study materials or patients: J Wang, Wan Chen, Q Wang, H Chen, J Chen; (IV) Collection and assembly of data: Y Zhou, J Wang, L Jin; (V) Data analysis and interpretation: Y Zhou, J Wang, L Jin, Z Li, Z Lin, X Li, J Li; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work as co-senior authors.

Correspondence to: Weirong Chen, MD; Duoru Lin, MD, PhD; Haotian Lin, MD, PhD. State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou, China. Email: chenwr_q@aliyun.com; lindr3@mail2.sysu.edu.cn; gddlht@aliyun.com.

Background: We aimed to evaluate the morphological characteristics of the subfoveal choroid and explore the possible association of these characteristics with best-corrected visual acuity (BCVA) in postoperative patients with unilateral congenital cataracts (CCs).

Methods: This was a cross-sectional study. Subfoveal choroidal structures were measured by spectral-domain optical coherence tomography with enhanced depth imaging (EDI-OCT). Several choroidal parameters, including subfoveal choroidal thickness (SFCT), total choroidal area (TCA), luminal area (LA), stromal area (SA) and choroidal vascularity index (CVI), were compared between pseudophakic and contralateral healthy eyes. Then, the choroidal parameters were compared between pseudophakic eyes with a poor BCVA (>0.3 logMAR) and those with a good BCVA (≤0.3 logMAR). The performance of the choroidal parameters in detecting a poor BCVA in pseudophakic eyes was evaluated by using the area under the receiver operating characteristic curve (AUC). A logistic regression model was used to assess the association between choroidal parameters and BCVA in postoperative patients with unilateral CCs.

Results: A total of 55 postoperative patients with unilateral CCs were included. The age was 6.67±2.64 years. Thinner SFCT and smaller TCA, LA, SA and CVI were observed in pseudophakic eyes than in contralateral healthy eyes. In addition, in pseudophakic eyes, those with a poor BCVA had a thinner SFCT and a smaller TCA, LA and SA than those with a good BCVA. TCA [AUC, 0.75; 95% confidence interval (CI), 0.62, 0.88], LA (AUC, 0.74; 0.61, 0.87) and SA (AUC, 0.74; 0.60, 0.87) showed acceptable discriminatory abilities on BCVA. Pseudophakic eyes with TCA ≤0.594 mm² [odds ratio (OR), 8.90; 95% CI: 1.99, 39.94; P=0.004], LA ≤0.402 mm² (OR 8.90; 95% CI: 1.99, 39.94; P=0.004) or SA ≤0.218 mm (OR, 6.53; 95% CI: 1.69, 25.27; P=0.007) were more likely to have a poor visual acuity.

Conclusions: The pseudophakic eyes in patients with unilateral CCs had thinner SFCT and smaller TCA, LA, SA and CVI than the contralateral healthy eyes. In pseudophakic eyes, smaller TCA, LA and SA values were associated with a poor visual acuity.

Keywords: Congenital cataracts (CCs); choroidal structures; best-corrected visual acuity (BCVA); optical coherence tomography with enhanced depth imaging

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Introduction

Congenital cataracts (CCs) are the leading cause of treatable childhood blindness and have a worldwide prevalence of 4.24/10,000 (1). Timely cataract extraction and intensive amblyopia treatment are the most effective therapies for patients with CCs. Despite this, the visual outcomes of cataractous patients vary greatly, ranging from useful visual acuity to blindness (2,3). Previous studies have suggested that cataract type (3), age at cataract extraction (4) and compliance with amblyopia therapy (5) are important determinants of visual outcomes for patients with CCs. Recently, it was also reported in unilateral CC patients' affected eyes had greater foveal retinal thickness than their healthy fellow eyes (6,7). However, it remains unclear whether the subfoveal choroid, the primary source of nutrients for the fovea, is involved in the pathogenesis and prognosis of CCs.

With the development of spectral-domain optical coherence tomography with enhanced depth imaging (EDI-OCT) techniques (8), investigation of the choroid is not limited to choroidal thickness; rather, the components of the choroid, including blood vessels and stromal tissue (e.g., connective tissue, melanocytes, nerves and extracellular fluid), can be examined in detail (9). Through binarization of choroidal images (8), choroidal angioarchitecture can be quantified by calculating the total choroidal area (TCA), luminal area (LA), stromal area (SA) and choroidal vascularity index (CVI). The CVI is calculated by determining the ratio of the vascular LA to the TCA and has been demonstrated to provide information on pathological changes in the choroid. Ratra *et al.* (10) compared the choroidal structures of eyes with Stargardt disease to those of healthy eyes and observed that the former had comparable subfoveal choroidal thickness (SFCT) but a significantly lower CVI, which indicated a decrease in blood vessels despite the compensatory increase in stromal tissue. Gupta *et al.* (11) observed a thinner choroidal thickness but a higher CVI in highly myopic patients than in emmetropic controls, suggesting a relatively greater reduction in stromal tissue than in blood vessels. To date, few studies (12,13) have investigated the morphological characteristics of the subfoveal choroid in eyes after CC surgery. In this study, we aimed to analyze the structures of the subfoveal choroid in terms of several choroidal parameters (SFCT, TCA, LA, SA and CVI) and further explore their association with best-corrected visual acuity (BCVA) in postoperative patients with unilateral CCs. We present the following article in accordance with the STROBE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1155/rc).

Methods

This was a cross-sectional study conducted from October 1, 2020, to February 28, 2021, at the Zhongshan Ophthalmic Center. Due to the occlusion of cataracts, capturing optimal choroidal images of the cataractous eyes preoperatively was challenging; therefore, patients aged 3 years and older, preoperatively diagnosed with unilateral CCs and underwent cataract extraction with intraocular lens (IOLs) implantation were included. Patients with a history of premature birth, a preoperative diagnosis of noncongenital cataracts or other ocular diseases, or poor cooperation in the ophthalmic evaluation were excluded. Preoperatively, CCs were generally subgrouped into total CCs and partial CCs based on cataract morphology. Briefly, CCs were defined as total CCs when the whole fundus was completely invisible because of lens opacity; otherwise, CCs were defined as partial CCs. Postoperatively, all patients were prescribed spectacles and an adhesive occlusive patch to wear over the contralateral healthy eye for one-half of their waking hours starting one week after cataract surgery. The spectacles were changed if the refractive power changed more than 1 diopter during every 3-month routine screening period. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Ethics Committee of the Zhongshan Ophthalmic Center, Sun Yat-sen University (No. 2020KYPJ149), and informed consent was taken from all the Children's parents.

Routine ophthalmic examinations

The demographic characteristics, including age, sex and laterality of the pseudophakic eyes, of the included patients were collected. To avoid the effects of postoperative inflammation on the measurements of choroidal parameters, all ophthalmic examinations were performed on each patient at least 3 months after surgery. Axial length was measured using IOL Master (Carl Zeiss Meditec, Oberkochen, Germany). Intraocular pressure (IOP) was assessed by using a noncontact tonometer (Topcon CT80A Computerized Tonometer, Topcon, Tokyo, Japan). A slit-lamp (BX900; HAAG-STREIT AG, Bern, Switzerland) examination was performed to evaluate the IOL position and the postoperative conditions. Fundus examination was carried out by EDI-OCT (Cirrus 5000, Zeiss Meditec, California,

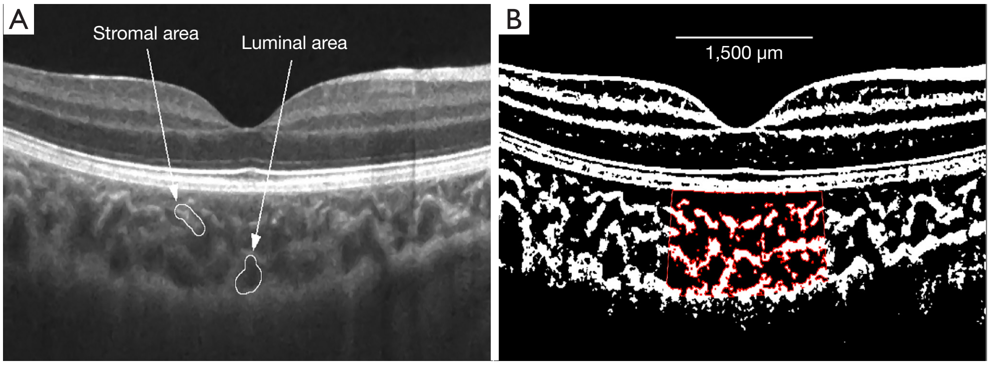

Figure 1 Binarization analysis of an EDI-OCT image. (A) Original EDI-OCT image. (B) Segmented EDI-OCT image by using the image binarization approach. The subfoveal choroidal area with a width of 1,500 μm centered on the foveola was analyzed. EDI-OCT, optical coherence tomography with enhanced depth imaging.

USA). Visual acuity was tested by a qualified ophthalmologist by using an E optotype (NIDEK SC-1600P, Japan). "E" cards were used to familiarize the younger patients with the material before the visual examination. Then, the test began with both eyes open at Line 0.1 to determine whether the children understood the "rules". If they were not able to complete the test, more teaching time was allotted until the patients had learned the rules. Then, the visual acuity was converted to logMAR for statistical analysis.

Measurements of choroidal structures

To minimize any potential impacts of diurnal variation, all patients were examined by EDI-OCT between 9 and 11 AM. A horizontal, high-definition, 21-line foveal scan was acquired for each eye and images with signal strength ≥7/10 were included. SFCT was measured by two independent observers (YZ and JHW) as the thickness between the outer border of the retinal pigment epithelium (RPE) and the choroid-scleral interface centered at the base of the fovea. The average of the two measurements from each observer was included for analysis. For intraobserver reproducibility, these two measurements for each patient from each observer were compared. For interobserver reproducibility, the measurements from observers were compared. The reproducibility was assessed by an intraclass correlation coefficient (ICC).

ImageJ (version 1.53a; http://imagej.nih.gov/ij/) was selected to perform image binarization according to the protocol proposed by Sonoda *et al.* (8). Representative results are shown in *Figure 1*. Briefly, a subfoveal choroidal region measuring 1,500 μm in diameter and centered on the foveola was selected as the region of interest. Then, the average luminance of three choroidal vessels with lumens larger than 100 μm was set as the minimum value to minimize the noise in the choroidal image. The image was then downgraded to 8 bits and adjusted to a binary image. The binarized image was then converted to an RGB image and LA was determined. After the set scale parameters were adjusted, TCA and LA were automatically calculated. SA was obtained by subtracting LA from TCA and CVI was obtained by dividing LA by TCA.

Statistical analysis

Sample size was estimated considering a study power of 0.9 at a significance level of 0.05. Based on our preresearch results, at least 48 pairs of eyes would be required to detect a significant difference in SFCT of at least 39.70 μm with a standard deviation (SD) of 84.91 μm between pseudophakic and contralateral healthy eyes.

Continuous variables are presented as the mean ± SD and categorical variables are expressed as frequencies and percentages. Continuous variables were tested for normality by using Shapiro-Wilk tests and histograms. Differences in choroidal parameters between pseudophakic and contralateral healthy eyes were assessed by using a paired *t* test and a generalized estimating equation was then used to adjust for axial length. For pseudophakic eyes, BCVA was categorized as "good" (BCVA ≤0.3 logMAR) or "poor" (BCVA >0.3 logMAR) visual acuity according to the driving standards of the United States (14). Then, the choroidal parameters between pseudophakic eyes with a poor BCVA and those with a good BCVA were compared

Table 1 Demographic and clinical description of postoperative patients with unilateral CCs

Parameter	Pseudophakic eyes	Contralateral healthy eyes	P value
Age (years)	6.67±2.64	6.67±2.64	NA
Male, n (%)	25 (45%)	25 (45%)	NA
Right eye, n (%)	27 (49%)	28 (51%)	0.912
BCVA (LogMAR)	0.73±0.66	0.04±0.05	<0.001
IOP (mmHg)	14.82±2.72	14.73±3.00	0.784
AL (mm)	23.06±1.64	22.67±1.26	0.013

Continuous variables are shown as the mean ± standard deviation. CCs, congenital cataracts; BCVA, best-corrected visual acuity; IOP, intraocular pressure; AL, axial length; NA, not applicable.

Table 2 Comparisons of interocular choroidal parameters in postoperative patients with unilateral CCs

Parameter	Pseudophakic eyes	Contralateral healthy eyes	Paired *t*-test		GEE*	
			Difference (95% CI)	P value	Difference (95% CI)	P value
SFCT (μm)	300.78±78.25	338.44±50.66	−37.65 (−58.79, −16.52)	0.001	−29.24 (−45.37, −13.11)	<0.001
TCA (mm^2)	0.651±0.179	0.735±0.115	−0.084 (−0.141, −0.028)	0.004	−0.066 (−0.113, −0.020)	0.005
LA (mm^2)	0.433±0.121	0.499±0.084	−0.066 (−0.106, −0.025)	0.002	−0.053 (−0.087, −0.019)	0.002
SA (mm^2)	0.217±0.060	0.236±0.036	−0.019 (−0.036, −0.001)	0.035	−0.013 (−0.027, −0.001)	0.065
CVI (%)	66.61±1.97	67.76±2.20	−1.16 (−1.90, −0.42)	0.003	−1.09 (−1.80, −0.39)	0.002

Data are shown as mean ± standard deviation. *, data were adjusted for axial length. CCs, congenital cataracts; SFCT, subfoveal choroidal thickness; TCA, total choroidal area; LA, luminal area; SA, stromal area; CVI, choroidal vascularity index; CI, confidence interval; GEE, generalized estimating equation.

by using an independent *t*-test, and a generalized estimating equation was performed to adjust for age, axial length and preoperative types of CCs. To identify the discriminatory performance of choroidal parameters as indicators of postoperative BCVA, receiver operating characteristic (ROC) curve analysis was performed to calculate the area under the curve (AUC) and find an optimal cutoff point by using the Youden index. AUCs in the ranges of 0.6–0.7, 0.7–0.8, 0.8–0.9 and 0.9–1.0 were considered poor, acceptable, good and excellent discrimination, respectively (15). The discriminatory performance of different choroidal parameters was compared by using the DeLong test. Pseudophakic eyes were dichotomized based on the optimal cutoff points of the choroidal parameters. A logistic regression model was performed to assess the association between choroidal parameters and postoperative BCVA.

Statistical analysis was performed by using SPSS statistical software (version 24.0; SPSS, Inc., Chicago, IL, USA). A two-sided P value less than 0.05 was considered statistically significant.

Results

A total of 55 postoperative patients with unilateral CCs, including 34 total CC patients and 21 partial CC patients, were included in the final analysis. The mean patient age was 6.67±2.64 years. *Table 1* shows the demographic characteristics of all patients and the clinical characteristics of all pseudophakic and contralateral healthy eyes. The mean BCVA of pseudophakic eyes was 0.73±0.66 logMAR, which was worse than that of the contralateral healthy eyes (0.04±0.05, P<0.001). The axial length of pseudophakic eyes (23.06±1.64 mm) was significantly longer than that of the contralateral healthy eyes (22.67±1.26 mm) (P=0.013).

Choroidal parameters of pseudophakic eyes versus contralateral healthy eyes

For SFCT measurements, the interobserver ICC was 0.954 [95% confidence interval (CI): 0.934, 0.968; P<0.001] and the intraobserver ICC was 0.985 (95% CI: 0.951, 0.989; P<0.001). As shown in *Table 2*, the SFCT of pseudophakic

Table 3 Comparisons of choroidal parameters between pseudophakic eyes with a poor BCVA and those with a good BCVA in postoperative patients with unilateral CCs

Parameter	Eyes with a poor BCVA	Eyes with a good BCVA	*t*-test		GEE*	
			Difference (95% CI)	P value	Difference (95% CI)	P value
SFCT (μm)	283.77±90.16	322.75±53.60	−38.96 (−78.24, 0.29)	0.052	−46.58 (−76.20, −16.96)	0.002
TCA (mm²)	0.583±0.186	0.739±0.125	−0.156 (−0.240, −0.072)	0.001	−0.170 (−0.232, −0.108)	<0.001
LA (mm²)	0.387±0.124	0.494±0.087	−0.107 (−0.164, −0.050)	<0.001	−0.115 (−0.156, −0.075)	<0.001
SA (mm²)	0.196±0.063	0.245±0.044	−0.049 (−0.078, −0.020)	0.001	−0.055 (−0.077, −0.032)	<0.001
CVI (%)	66.43±1.65	66.84±2.35	−0.41 (−1.49, 0.70)	0.448	−0.026 (−0.1.32, 0.079)	<0.626

Data are shown as mean ± standard deviation. *, data were adjusted for age, axial length and preoperative types of CCs. BCVA, best-corrected visual acuity; CC, congenital cataract; SFCT, subfoveal choroidal thickness; TCA, total choroidal area; LA, luminal area; SA, stromal area; CVI, choroidal vascularity index; CI, confidence interval; GEE, generalized estimating equation.

Table 4 Odds ratios of choroidal parameters in pseudophakic eyes with BCVA worse than 0.3 LogMAR

Parameter	Adjusted OR (95% CI)	P value*
TCA (mm²)		0.004
TCA ≤0.594	8.90 (1.99, 39.94)	
TCA >0.594	Reference	
LA (mm²)		0.004
LA ≤0.402	8.90 (1.99, 39.94)	
LA >0.402	Reference	
SA (mm²)		0.007
SA ≤0.218	6.53 (1.69, 25.27)	
SA >0.218	Reference	

*, data were adjusted for age and preoperative types of cataracts. BCVA, best-corrected visual acuity; TCA, total choroidal area; LA, luminal area; SA, stromal area; OR, odds ratio; CI, confidence interval.

eyes was thinner than that of the contralateral healthy eyes (300.78±78.25 *vs.* 338.44±50.66 μm; P=0.001). Similarly, TCA (0.651±0.179 *vs.* 0.735±0.115 mm², P=0.004), LA (0.433±0.121 *vs.* 0.499±0.084 mm², P=0.002), SA (0.217±0.060 *vs.* 0.236±0.036 mm², P=0.035) and CVI (66.61±1.97 *vs.* 67.76±2.20, P=0.003) were found to be smaller in pseudophakic eyes than in the contralateral healthy eyes. These differences remained although they were marginally significant in SA after adjustment for axial length. In addition, in patients with preoperative total CCs, significant differences in SFCT, TCA, LA, SA and CVI between pseudophakic eyes and contralateral healthy eyes were found (Table S1). In contrast, no difference was found in patients with preoperative partial CCs (Table S2).

Comparisons of choroidal parameters between pseudophakic eyes with a poor BCVA and those with a good BCVA

As shown in *Table 3*, the pseudophakic eyes with a poor BCVA had a marginally thinner SFCT than those with a good BCVA (283.77±90.16 *vs.* 322.75±53.60 μm; P=0.052). In addition, TCA (0.583±0.186 *vs.* 0.739±0.125 mm², P=0.001), LA (0.387±0.124 *vs.* 0.494±0.087 mm², P<0.001) and SA (0.196±0.063 *vs.* 0.245±0.044 mm², P=0.001) were found to be significantly smaller in pseudophakic eyes with a poor BCVA. These differences persisted after adjustment for age, axial length and preoperative types of CCs.

Associations between choroidal parameters and postoperative BCVA in pseudophakic eyes

The AUCs of SFCT and CVI, at 0.63 (95% CI: 0.48, 0.77) and 0.55 (0.40, 0.71), respectively, indicated poor discrimination. Thus, the cutoff values for SFCT and CVI were not calculated. The AUCs of other variables were acceptable: 0.75 (0.62, 0.88) with a cutoff value of 0.594 mm² for TCA, 0.74 (0.61, 0.87) with a cutoff value of 0.402 mm² for LA and 0.74 (0.60, 0.87) with a cutoff value of 0.218 mm² for SA. In addition, TCA, LA and SA had greater AUCs than SFCT (all P<0.05), whereas the AUCs of TCA, LA and SA were comparable (all P>0.05).

As shown in *Table 4*, compared to pseudophakic eyes with TCA >0.594 mm², those with TCA ≤0.594 mm² had a higher risk of a poor BCVA [odds ratio (OR), 8.90; 95% CI: 1.99, 39.94; P=0.004]. Similarly, compared to pseudophakic eyes with LA >0.402 mm² or SA >0.218 mm², those with LA

≤0.402 mm² (OR 8.90; 95% CI: 1.99, 39.94; P=0.004) or SA ≤0.218 mm (OR, 6.53; 95% CI: 1.69, 25.27; P=0.007) also had a higher risk of a poor BCVA.

Discussion

In this study, reduced SFCT, TCA, LA, SA and CVI were observed in postoperative patients with unilateral CCs. In addition, we reported for the first time that pseudophakic eyes with smaller TCA, LA and SA tended to have worse visual acuity. Our findings may be helpful in understanding the morphological characteristics of the subfoveal choroid in postoperative patients with unilateral CCs, as well as their possible association with visual acuity.

The choroid, as a vascular structure supplying the outer retina, is of paramount importance to the visual function. To date, previous studies (16-18) have reported significant choroidal thickness alterations in strabismic/anisometropic eyes after adjustment for axial length and these changes partially regress after amblyopia treatment (16); however, studies on choroidal changes in eyes with CCs, the most common reason for form-deprivation amblyopia, have been rarely reported. Daniel *et al.* (13) found reduced SFCT in pseudophakic eyes, which was similar to our findings. However, they included patients after both bilateral and unilateral CC surgery, as well as those with concomitant secondary glaucoma. These patients may be complicated with choroidal abnormalities (19,20). In the current study, only postoperative patients with unilateral CCs without any other ocular diseases were included, eliminating the effects of age (21), systolic blood pressure (22) and concomitant diseases. Daniel *et al.* did not report measurements of axial length, which was previously demonstrated to be an important factor affecting choroidal thickness (23,24). In the current study, even a longer axial length in pseudophakic eyes than in contralateral healthy eyes was observed, and the interocular choroidal differences were persistent after adjusting for axial length. Although some associations between refractive error and choroidal structures may exist, the postoperative refractive data of the patients were not included due to the retrospective design of this study. However, in our patients, spectacles were prescribed in a timely manner, accompanied by timely supervision and guidance for wearing spectacles after surgery, to correct the residual refractive error after IOL implantation. These measures may minimize the effects of refractive error on choroidal parameters. In addition, we also roughly grouped CCs into total CCs and partial CCs based on the preoperative morphology of cataracts and found that the types of CCs may be somewhat associated with choroidal abnormalities. Furthermore, except for identifying the changes in choroidal thickness, we provided more details on the choroidal changes, which may be helpful in exploring the pathological changes of the pseudophakic eyes; however, given the cross-sectional design of the current study, we could not conclude whether the choroidal changes occurred before or after the cataract surgery. Further studies are still needed to resolve these issues.

Previous studies have reported associations between thinner choroids and a poor BCVA in patients with/without major ocular diseases (e.g., myopia, age-related macular degeneration) (25,26). In our study, we observed that the pseudophakic eyes with a poor BCVA had thinner SFCT and smaller TCA, LA and SA than the ones with a good BCVA. To evaluate the discriminatory ability of choroidal parameters on BCVA in postoperative patients with unilateral CCs, we performed a ROC analysis to measure AUCs and identify cutoff values that appeared to be associated with a poor visual acuity. According to the AUCs obtained, TCA, LA and SA exhibited a better discriminatory ability than SFCT. This outcome may be due to the different calculation methods for these choroidal parameters. Choroidal thickness, as defined in this study, reflects the thickness of the subfoveal choroid only at a certain measurement site and may vary greatly depending on the selected measurement site, whereas TCA, LA and SA represent specific components of the whole subfoveal choroid. Notably, TCA, LA and SA had limited performance in postoperative visual assessments. This might be partly due to other factors influencing the visual prognosis. Nonetheless, we found that pseudophakic eyes with smaller TCA, LA and SA were more likely to have a poor visual acuity. These findings indicated that the poor visual prognosis of postoperative patients with unilateral CCs may be associated with compromised choroidal circulation. Pediatric ophthalmologists may take the choroidal status of the pseudophakic eyes into consideration when evaluating their visual prognosis and implement personalized treatments for those with a high risk of a poor visual prognosis (e.g., more intensive amblyopia training and follow-up).

When interpreting the results of this study, one must consider the following drawbacks. First, due to the cross-sectional design, the time when the choroidal abnormalities occurred and how they dynamically changed remains unclear. Accordingly, longitudinal postsurgery studies evaluating the choroidal parameters at different time points are urgently needed. Regardless, our study may lay the foundation for further study of the subfoveal choroid in CCs. Second, the OCT operating software did not provide automatic measurements of choroidal parameters. Subjective manual measurement may lead to bias; however, this study may have mitigated that risk to some extent through repeated measurements by two independent observers. Third, the study was performed in postoperative patients with unilateral CCs, and caution should be taken when generalizing the findings to other cataract patients. Fourth, we did not evaluate the association between postoperative amblyopic treatments and choroidal parameters because of the cross-sectional design. We plan to undertake further studies to answer these questions.

In conclusion, in postoperative patients with unilateral CCs, pseudophakic eyes had thinner SFCT and smaller TCA, LA, SA and CVI than the contralateral healthy eyes. In addition, smaller TCA, LA and SA values may be associated with worse visual acuity in pseudophakic eyes.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1155/rc

Data Sharing Statement: Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1155/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1155/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Ethics Committee of the Zhongshan Ophthalmic Center, Sun Yat-sen University (No. 2020KYPJ149), and informed consent was taken from all the Children's parents.

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Supplementary

Table S1 Comparisons of interocular choroidal parameters in postoperative patients with preoperative total CCs

Parameter	Pseudophakic eyes	Contralateral healthy eyes	Paired *t*-test		GEE*	
			Difference (95% CI)	P value	Difference (95% CI)	P value
SFCT (μm)	293.06±80.31	350.47±46.82	−57.41 (−84.17,−30.66)	<0.001	−49.06 (−70.96, −27.16)	<0.001
TCA (mm²)	0.624±0.178	0.759±0.101	−0.135 (−0.206,−0.063)	0.001	−0.115 (−0.176, −0.053)	<0.001
LA (mm²)	0.414±0.119	0.518±0.075	−0.104 (−0.155,−0.053)	<0.001	−0.091 (−0.136, −0.046)	<0.001
SA (mm²)	0.210±0.061	0.241± 0.032	−0.031 (−0.053,−0.009)	0.006	−0.024 (−0.042, −0.005)	0.011
CVI (%)	66.35±1.57	68.17± 2.10	−1.82 (−2.70, −0.95)	<0.001	−0.019 (−0.027, −0.010)	<0.001

*, data were adjusted for axial length. CC, congenital cataract; SFCT, subfoveal choroidal thickness; TCA, total choroidal area; LA, luminal area; SA, stromal area; CVI, choroidal vascularity index; CI, confidence interval; GEE, generalized estimating equation.

Table S2 Comparisons of interocular choroidal parameters in postoperative patients with preoperative partial CCs

Parameter	Pseudophakic eyes	Contralateral healthy eyes	Paired *t*-test		GEE*	
			Difference (95% CI)	P value	Difference (95% CI)	P value
SFCT (μm)	313.29±75.00	318.95±51.64	−5.67 (−38.06, 26.73)	0.719	−1.68 (−21.04, 17.68)	0.865
TCA (mm²)	0.694±0.175	0.697±0.128	−0.002 (−0.091, 0.086)	0.958	0.006 (−0.057, 0.069)	0.850
LA (mm²)	0.465±0.121	0.469±0.092	−0.003 (−0.065, 0.058)	0.912	0.003 (−0.041, 0.046)	0.906
SA (mm²)	0.229±0.059	0.228±0.404	0.001 (−0.028,0.030)	0.942	−0.003 (−0.018, 0.025)	0.757
CVI (%)	67.03±2.48	67.10±2.26	−0.07 (−1.35, 1.20)	0.903	−0.03 (−0.012, 0.011)	0.960

*, data were adjusted for axial length. CC, congenital cataract; SFCT, subfoveal choroidal thickness; TCA, total choroidal area; LA, luminal area; SA, stromal area; CVI, choroidal vascularity index; CI, confidence interval; GEE, generalized estimating equation.

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