Changes In Retinal Thickness And Vessel Density After Phacoemulsification With OCTA In Cataract

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Research Article

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Abstract

Purpose. To study the effects of phacoemulsification combined with intraocular lens implantation on macular thickness, vessel density and optic disc thickness by OCTA.

Methods. A retrospective study. Patients with age-related cataract diagnosed were collected, and all of them underwent phacoemulsification combined with intraocular lens implantation. All patients had completed ophthalmologic examinations, including UCVA in logarithm of the minimum angle of resolution (logMAR), IOP, AL, a slit-lamp microscope, B-scans, corneal endothelioscopy, funduscopic photography and retinal thickness and blood flow drensity were measured by OCTA. Follow-up was 1 day, 1 week, 1 month, and 3 months postoperatively.

Results. A total of 25 patients (38 eyes) were enrolled in this study. The UCVA and macular inner thickness were increased while IOP was decreased($P<0.001$). This study showed that the thickness of macular and RNFL decreased on the first day postoperative ($P<0.001$), and increased at 3 months postoperatively ($P<0.001$). Meanwhile, vessel density in macular area and optic disc area decreased on the first postoperative day compared with that before surgery, and then showed an increasing trend. However, there was no statistical significance in the changes of vessel density in deep macular area and optic disc area($P>0.05$).

Conclusions. In conclusion, the results of this study indicate that macular thickness, inner retinal thickness, and RNFL decreased on the first day after phacoemulsification and then increased at 3 months. The vessel density in the deep macular and superficial layers, the whole image and inside disc vessel density were increased, while the blood flow density in peripapillary is decreased. As a non-invasive method, OCTA provides a good guide for the decision of cataract surgery.

Introduction

Cataract is a leading cause of reversible blindness worldwide.[1] Phacoemulsification combined with intraocular lens implantation, the most common treatment for cataract at present, has the benefit of less tissue injury, faster incision healing, and better postoperative vision. Numerous studies have shown that better visual acuity and good visual quality can be obtained after surgery.[2–4] With the development of phacoemulsification instruments, surgeons are increasingly pursuing rapid surgery with high negative pressure and a high flow rate, which require high perfusion pressure. However, high intraocular pressure (IOP) caused by high perfusion pressure may bring potential surgical risks. Retinal tissue is rich in blood vessels to provide the oxygen nutrients needed by the ocular tissue. Increased IOP can disrupt the retinal blood flow balance, resulting in ischemic lesions of the fundus. It has been reported that after phacoemulsification combined with intraocular lens implantation, the blood flow density and thickness of the macular and optic papilla change, but the division is relatively simple.[5, 6]

As a new and non-invasive examination technique, optical coherence tomography angiography (OCTA) can provide depth information of retinal vessels *in vivo*.[7] The retina and choroid images obtained by split-spectrum amplitude-decorrelation angiography (SSADA) have fewer artifacts than traditional OCT techniques.[8]The purpose of this research was to study the effects of phacoemulsification combined with intraocular lens implantation on macular thickness, vessel density, and optic disc thickness by OCTA to provide clinical guidance before and after cataract surgery to obtain better postoperative vision and visual quality.

Patients And Methods

This study is retrospective in nature.

Patients

Data from patients with age-related cataracts diagnosed at the Ningbo Aier Guangming Eye Hospital from January 2021 to July 2021 were collected. All patients had undergone phacoemulsification combined with intraocular lens implantation. The exclusion criteria included the following: history of ocular trauma, internal eye surgery, and other ocular diseases (e.g., glaucoma, macular hole, macular degeneration, retinal detachment, diabetic retinopathy, retinal vascular obstructive disease, uveitis, fundus tumor, etc.).

All patients had complete ophthalmologic examinations, including the measurement of uncorrected distance visual acuity (UCVA) in logarithm of the minimum angle of resolution (logMAR), the measurement of IOP with a noncontact tonometer, the measurement of axial length (AL) with partial coherence interferometry (IOL-Master), and the use of a slit-lamp microscope, B-scans, corneal endothelioscopy, funduscopic photography, and OCTA (OptoVue Company, USA, Quantification 2.0). The follow-up periods were one day, one week, one month, and three months postoperatively.

Operation Method

All operations were performed by the same surgeon, and each patient signed an informed consent form before the operation. Local anesthesia with 0.5% propimecaine hydrochloride eye drop. After a 2.0 mm clear corneal incision was made, continuous capsulorhexis, hydrodissection, intracapsular phacoemulsification cataract extraction, irrigation/aspiration cortex removal, and posterior capsule polish were sequentially performed. An intraocular lens was then implanted in the capsular bag. The operation parameters were set as follows: a maximum ultrasonic energy of 60%, a maximum negative pressure of 350 mmHg, and the height of the perfusion fluid at 95 cm.

Detection Of Optical Coherence Tomography Angiography

OCTA scans were obtained using RTVue-XR Avanti (OptoVue Company, USA, Quantification 2.0). The HD Angio Disc 4.5 mm × 4.5 mm scanning mode was selected, and the optic papilla capillaries and all blood vessels were scanned with the optic papilla at the center (Fig. 2). The macular 3 mm × 3 mm program was selected to cover the foveal 3-mm area (Fig. 1). The retinal capillary blood flow density in the 3-mm area of the macular region was measured using equipment software. In the measurement of macular retinal thickness, retinal thickness refers to the average thickness of a specific area, and full retinal thickness refers to the distance from the ILM to the RPE–Bruch membrane complex. Inner retinal thickness was defined as the retinal thickness from the ILM to the IPL. The superficial retina was defined as ranging from ILM to 10 μm above the IPL. The deep retina was defined as 10 μm above the IPL to 10 μm below the OPL. OCTA images with image quality (scan quality) < 6 stroke 10 were excluded. All examinations were performed by the same experienced clinician. The changes in retinal thickness in the macular area and optic papilla area were measured before the operation and one day, one week, one month, and three months postoperatively. Changes in blood flow density in the superficial and deep macular areas were also measured.

Statistical Analysis

SPSS 24.0 statistical software was used to analyze the data. The basic description of the measurement data is expressed as mean ± standard deviation and median. The retinal thickness and blood flow density before the operation and one day, one week, one month, and three months postoperatively were compared using a single-factor repeated-measurement analysis of variance (ANOVA). The correlation coefficient of Pearson product difference was used to explain the correlation between AL and optic disc difference. P < 0.05 indicates that the difference was statistically significant.

Results

Baseline Data

A total of 25 patients (38 eyes) were enrolled in this study. The mean age of the participants was 64.55 ± 8.47 years (8 males and 17 females). The mean preoperative uncorrected visual acuity was 0.79 ± 0.54. The mean preoperative IOP was 14.27 ± 2.53 mmHg. The average AL was 24.04 ± 2.17 mm. The mean preoperative corneal thickness was 533.63 ± 33.29 mm.

UCVA improved significantly at one day, one week, one month, and three months postoperatively, with mean values of 0.17 ± 0.22 (*P*□0.001), 0.24 ± 0.27 (*P*□0.001), 0.24 ± 0.27 (*P*□0.001), and 0.21 ± 0.26 (*P*□0.001), respectively. After surgery, IOP initially increased and then decreased to 16.72 ± 3.27 at one day (P□0.001), 14.08 ± 2.87 at one week (P□0.001), 12.78 ± 2.21 at one month (P□0.001), and 13.47 ± 2.26 at three months (P□0.001) postoperatively. In addition, the inner thickness of the retina increased from 48.23 ± 13.24 mm preoperatively to 46.49 ± 13.52 at one day, 47.43 ± 13.95 at one week, 49.71 ± 13.51 at one month, and 51.8 ± 13.63 mm at three months postoperatively (*P*□0.024).

Thickness of the Macular and Retinal Nerve Fiber Layers

This study showed that on the first postoperative day, the perifovea of the macula's thickness showed a decreasing trend, except in the tempo, nasal, and inferior quadrants, followed by an increasing trend. At three months postoperatively, macular thickness was significantly increased (*P*□0.001))(except for the superior and nasal quadrants in the parafovea). We found that the thickness of the retinal nerve fiber layer (RNFL) around the optic disc decreased on the first postoperative (*P*□0.001) and increased at three months postoperatively (*P*□ 0.001) (Tables 1 and 4).

Superficial Vessel Density in the Macula

In this study, vessel density in the superficial layer of the macula increased significantly three months after surgery (*P*□0.001), except in the tempo and superior quadrants in the perifovea. We also observed a significant decrease in superficial macular blood flow density in almost all areas on the first postoperative day (Table 2).

Deep Vessel Density in the Macula

Our study found an increase in macular deep vessel density at three months postoperatively compared to the preoperative level, but it was not statistically significant (except in the superior quadrant of the perifovea). On the first postoperative day, the deep vessel density in the whole image and fovea decreased compared with that before surgery, but in the parafovea and perifovea, they increased (Table 3).

Capillary Density in the Disc

This study showed that the capillary density in the disc in the whole image and peripapillary region decreased, and inside the disc, it increased on the first postoperative day (P [illegible] 0.05). Three months postoperatively, the whole image and the area inside the disc increased in capillary density (P [illegible] 0.05) (Table 5).

Discussion

It is well known that phacoemulsification combined with intraocular lens implantation is the most effective surgical method for cataract treatment at present. The complications of this operation are rare, but a small number of patients still have poor postoperative results, and macular degeneration may be the main reason.[9] Studies have shown that during phacoemulsification, some posterior vitreous detachment or anterior displacement will occur, and the fovea macula and surrounding tissues will be pulled, resulting in edema or thickening.[10, 11] Other studies have reported that using the high perfusion mode during phacoemulsification can affect retinal thickness and blood flow and can even lead to the occurrence of early optic nerve ischemic lesions.[12] It has been indicated that acute increases in IOP can induce ischemia-reperfusion injury, which may cause retinal ganglion cell death and damage to the optic nerve and retina.[13, 14] However, the effect of phacoemulsification on macular vessel density changes remains unclear.

As a new kind of quantitative measurement of ocular blood flow, OCTA's measurement principle is in the same spot over retinal horizontal motion contrast scanning, and repeated scanning of certain areas of the fundus forms 3D data. These data, through multiple transverse scans, display structure changes and receive signals related to blood flow and blood cell movement. The results included all information regarding superficial retinal vessels, deep retinal vessels, and choroidal vessels. In addition, the SSADA algorithm is applied to improve the flow detection of the signal-to-noise ratio and the coherence of the capillary network. Another advantage of OCTA over conventional OCT is that 3D data images obtained after stratified scanning can show information at all levels of the retina, which helps in its detection and evaluation.7–8 As a non-invasive, non-injected contrast agent and time-free fundus vascular detection method, the purpose of this study was to measure the macular area, optic papillary omental thickness, and blood flow changes after phacoemulsification with OCTA quantification standard 2.0.

The results of this study suggested that the inner thickness in the macular region increased gradually after phacoemulsification, but the full thickness in the macular region decreased on the first postoperative day and followed an increasing trend. Three months postoperatively, the macular thickness increased significantly compared with before surgery. Yasuko et al. observed a macular thickness increase up to three months post-cataract surgery in both diabetic and non-diabetic eyes, which was mainly the result of an inflammatory response after cataract surgery.[15]Our results were consistent with these. Likewise, Zhao et al. found that after phacoemulsification of cataract, the thickness of the macular area increased, was mainly confined to the inner layer, and still showed an increasing trend one and three months after surgery.[6]Previous studies have shown that changes in retinal thickness after phacoemulsification are associated with rupture of the blood–retina barrier.[16–18]

This study showed that the thickness of the RNFL increased after phacoemulsification, and El-Ashry et al. reached a consistent conclusion.[19] Studies have shown that high IOP compresses retinal blood flow and reduces blood supply, leading to ischemia and hypoxia of retinal ganglion cells and the fiber layer, the death of axons, and edema of the RNFL.[12, 20] In this study, IOP increased on the first day after surgery, followed by a decreasing trend. It was considered that transient IOP increased after phacoemulsification for cataract, resulting in increased nerve fiber layer thickness. Zhao et al. reported that the thickness of RNFL decreased on the first day after surgery, followed by an increasing trend. We also considered the influence of elevated acute IOP on macula thickness and RNFL.[21]

Our study showed that after phacoemulsification for cataract, the vessel density in the superficial macula increased, while the change in the vessel density in the deep macula was not significant. The results of this study indicated that on the first postoperative day, most zones of superficial macular vessel density showed a decreasing trend, followed by an increasing trend, while most zones of deep macular vessel density continued to increase. It has been reported that increased macular perfusion after phacoemulsification is caused by macular functional congestion and speculated that this effect is caused by increased retinal light intensity stimulation after cataract extraction. These results suggest that ultrasonic emulsification has a greater clinical advantage in the elderly population.[22]

This study showed that the whole image and inside disc blood flow had an increasing trend, but peripapillary vessel density had a decreasing trend. However, these trends were not statistically significant, which was consistent with the four-week clinical follow-up study by Karabulut et al., who reported a negative correlation between vascular density and IOP, which was confirmed at weeks one and four.[5]Liu et al. revealed that the deep microvascular density in the parafovea and perifovea were increased, with enhanced pulsatile ocular blood flow after phacoemulsification, which might have attributed to the decreased mean IOP.[23]In our study, IOP showed a trend of first increasing and then decreasing, while macular blood flow showed an opposite trend, suggesting a negative correlation.

This study monitored only changes in retinal thickness and blood flow density after phacoemulsification in the macular area and the papilla area of the optic nerve in early cataract. More data are needed to support this finding.

In conclusion, the results of this study indicate that macular thickness, inner retinal thickness, and RNFL decreased on the first day after phacoemulsification and then increased at one month and three months postoperatively. The vessel density in the deep macular and superficial layers, the whole image, and the inside disc vessel density increased, while the blood flow density in the peripapillary decreased. As a non-invasive method, OCTA provides a good guide when considering cataract surgery, especially in the elderly.

Abbreviations

OCTA: optical coherence tomography angiography, SSADA: split-spectrum amplitude-decorrelation angiography, UCVA: uncorrected distance visual acuity, AL: axial length.

Declarations

Acknowledgements

Not applicable.

Authors' contributions

Ganying Jin contributed to conception and design, acquisition of data, and interpretation of data. Qi Li was a major contributor in writing the manuscript, analyzed and interpreted the patient data. Dongrui Hu and Qingsen Zeng contribution to conception and design, acquisition of data. All authors gave final approval of the version to be published and agree to be accountable for all aspects of the work.

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Availability of data and materials

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

Ethics approval and consent to participate

Informed consent was signed from every patient and their relatives. Approval of protocol was obtained from the Ethical Committee of Ningbo Aier Guangming Eye hospital. Record related to patient was anonymous and de-identified prior to analysis. The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1. The thickness of macular

	The thickness of macular (μm)					
	preoperative	1 day	1 week	1 month	3 months	*P*
Whole image	272±26.15	271.06±23.41	273.97±24	280.24±21.68	280.53±22.56	<0.001
Superior-Hemi	276.55±22.2	275.91±21.45	278.3±22.43	285.03±21.48	285.85±21.78	<0.001
Inferior-Hem	267.94±32.45	267.29±25.96	270.74±26.56	277±23.02	276.79±23.79	<0.001
Fovea	252.97±24.57	251.47±27.53	251.44±23.09	255.62±22.77	257.94±22.07	0.001
ParaFovea	310.91±23.53	309.5±22.73	312.71±24.04	316.18±26.5	319.74±23.47	<0.001
-Superior-Hemi	312.5±24.55	311.65±23.05	311.97±20.76	321±23.98	321.85±24.82	<0.001
-Inferior-Hemi	309.41±24.07	307.03±23.46	307.41±27.16	315.91±25.01	317.59±23.26	<0.001
-Tempo	302.5±22.79	300.21±22.63	303.47±23.41	309.09±22.92	310.12±22.63	<0.001
-Superior	315.16±25.92	314.97±23.42	317.62±23.57	324.42±23.88	326±26.41	0.161
-Nasal	316.87±25.53	315.21±24.14	317.54±25.85	324.18±27.62	325.66±26.99	0.314
-Inferior	308.94±27.28	307.15±25.7	310±27.7	315.74±27.61	317.94±24.36	<0.001
PeriFovea	270.5±27.09	270.24±22.89	273.06±23.58	279.29±22.66	279.71±22.28	<0.001
-Superior-Hemi	277.03±21.99	276.18±20.95	278.7±21.43	284.94±20.47	288.79±25.25	<0.001
-Inferior-Hemi	264.97±34.68	265.74±24.9	268.41±26.41	274.74±24.79	273.79±24.73	<0.001
-Tempo	254.39±34.52	254.45±29.47	257.55±28.8	264.45±24.05	266.24±22.4	<0.001
-Superior	278.18±20.44	277.24±20.11	279.42±19.9	285.21±20	286.42±21.86	<0.001
-Nasal	292.85±30.78	293.73±24.8	296.24±24.61	302.27±25.19	301.97±24.92	<0.001
-Inferior	258.5±37.93	259.65±25.88	261.97±29.35	268.71±25.64	268.15±25.42	<0.001

Table 2. Superficial Vessel Density in macular

	Superficial Vessel Density in macular（%）					
	preoperative	1 day	1 week	1 month	3 months	*P*
Whole image	44.84±4.03	43.87±4.1	45.83±5.29	45.84±5.38	47.09±4.87	0.001
Superior-Hemi	44.94±4.17	44.68±4.71	46.49±4.97	46.12±5.72	47.56±4.56	0.004
Inferior-Hemi	44.74±3.98	43.24±3.97	45.26±5.62	45.61±5.2	46.78±5.26	<0.001
Fovea	16.95±7.77	15.96±6.94	17.52±7	17.01±6.23	20.66±7.57	0.005
ParaFovea	44.47±5.61	43.48±6.5	46.82±7.2	46.87±7.27	48.98±4.86	<0.001
-Superior-Hemi	44.56±6.1	44.92±6.32	47.93±7.38	47.01±8.6	49.35±4.65	<0.001
-Inferior-Hemi	44.37±5.77	43.25±5.95	45.7±7.49	46.73±6.67	48.61±5.32	<0.001
-Tempo	44.62±7.4	44.27±9.29	47.99±6.99	48.21±5.85	48.85±5.16	0.008
-Superior	44.66±8.22	45.24±7.97	48.06±9.6	47.23±9.36	49.29±6.67	0.025
-Nasal	44.31±6.35	43.27±6.29	46.15±5.87	45.52±8.55	48.88±4.1	<0.001
-Inferior	44.27±6.7	43.55±7.51	45.1±9.37	46.52±8.11	48.92±6	0.003
PeriFovea	45.69±4.4	45.15±3.88	46.93±5.6	46.54±5.3	47.71±4.93	0.019
-Superior-Hemi	46.06±4.45	45.65±4.44	47.72±5.19	46.74±5.62	48.41±4.35	0.01
-Inferior-Hemi	45.54±4.59	44.52±3.71	46.49±6.07	46.59±5.16	47.26±5.59	0.013
-Tempo	41.99±5.72	40.84±5.1	43.28±5.59	42.47±6.01	43.37±6.91	0.222
-Superior	46.29±5.27	46.09±5.11	47.53±6	47.08±5.8	48.43±4.53	0.108
-Nasal	49.38±4.23	48.49±6.86	51.08±5.65	50.73±4.92	51.87±4.42	0.01
-Inferior	45.58±5.2	44.6±4.01	46.17±6.42	46.7±5.45	47.23±6.43	0.029

Table 3. Deep Vessel Density in macular

	Deep Vessel Density in macular（%）					
	preoperative	1 day	1 week	1 month	3 months	*P*
Whole image	42.42±6.13	41.95±5.12	42.78±7.08	43.2±6.51	43.38±5.02	0.824
Superior-Hemi	42.39±6.92	43.02±5.15	44.59±5.68	45.15±5.61	44.12±4.84	0.131
Inferior-Hemi	42.43±5.84	41.08±5.66	42.9±5.8	43.19±4.82	42.68±5.33	0.409
Fovea	31.55±9.73	31.12±8.59	32.98±6.46	32.42±7.6	33±8.41	0.567
ParaFovea	49.15±7.8	50.28±6.26	50.78±5.07	51.02±3.83	50.32±4.25	0.659
-Superior-Hemi	49.26±8.84	50.88±6.23	51.29±4.45	51.04±5.1	50.69±4.14	0.754
-Inferior-Hemi	49.05±7.9	49.69±6.93	50.27±6.35	51.01±3.58	49.98±4.96	0.535
-Tempo	49.77±10.16	51.89±5.87	52.85±3.49	52.36±3.86	51.43±3.93	0.216
-Superior	48.21±9.43	49.63±7.23	49.75±5.9	50.18±5.54	49.25±5.35	0.874
-Nasal	51.02±8.28	51.56±8.04	52.68±4.26	52.38±5.3	52.23±4.07	0.712
-Inferior	47.65±8.87	48.06±8.01	47.82±10.06	49.2±4.91	48.39±5.6	0.825
PeriFovea	42.63±6.92	43.12±5.82	44.32±6.3	44.82±5.68	44.31±5.4	0.371
-Superior-Hemi	42.77±7.89	43.61±5.86	45.04±6.48	46.08±6.14	44.98±5.15	0.12
-Inferior-Hemi	42.5±6.71	41.88±6.59	43.58±6.36	43.68±5.77	42.63±7.33	0.628
-Tempo	46.31±8.03	46.66±6.51	48.49±5.69	48.38±5.38	48.24±5.08	0.357
-Superior	40.57±8.03	41.23±6.94	43.55±7.41	44.98±6.99	43.84±6.18	0.009
-Nasal	41.62±7.47	42.69±7.28	43.3±7.9	43.87±6.39	42.67±5.77	0.497
-Inferior	41.77±7.48	40.3±6.99	41.81±6.53	42.14±6.68	41.78±7.24	0.721

Table 4. RNFL thickness in disc

	RNFL thickness in disc（μm）					
	preoperative	1 day	1 week	1 month	3 months	*P*
Peripapillary	105.36±14.3	101.27±19.01	103.12±19.69	108.7±20.12	108.21±19.71	< 0.001
-Superior-Hemi	106.94±15.89	101.36±19.34	103.97±19.38	108.48±19.71	110±20.68	< 0.001
-Inferior-Hemi	103.52±16.73	101.18±19.85	102.15±20.81	108.76±22.28	106.36±20.69	< 0.001
-Nasal Superior	103.76±29.15	92.64±15.88	95.48±15.94	100.52±17.36	106.94±53.93	0.005
-Nasal Inferior	84.12±19.45	79.67±15.39	80.67±15.73	86.55±15.53	87.09±22.55	0.001
-Inferior Nasal	120.61±27.22	119.42±28.6	120.45±29.63	126±31.76	124.91±30.34	0.001
-Inferior Tempo	139.45±36.75	136.88±38.82	137.64±39.71	145.48±42.96	141.27±41.31	< 0.001
-Tempo Inferior	72.76±17.39	72.12±14.54	72.91±14.6	81.33±24.53	74.61±14.34	0.008
-Tempo Superior	79.21±13.68	76.03±15.72	77.73±13.19	81.42±13.9	81.39±13.22	0.004
-Superior Tempo	125.18±28.11	122.58±30.99	125.94±31.31	131.85±30.45	129.09±32.39	< 0.001
-Superior Nasal	126.44±30.67	122.91±32.09	126.59±33.23	130.28±34.77	130.69±34.82	< 0.001

Table 5. Capillary Density in disc

	Capillary Density in disc（%）					
	preoperative	1 day	1 week	1 month	3 months	*P*
Whole image	46.33±5.25	46.21±5.45	46.45±5.5	46.27±5.6	46.46±5.06	0.98
Inside Disc	45.53±9.13	46.43±7.14	46.79±7.66	47.82±6.64	47.28±5.91	0.479
Peripapillary	48.78±6.76	48.25±7.24	48.34±7.39	47.77±7.61	46.83±9.58	0.474
-Superior-Hemi	49.24±7.02	48.27±7.66	48.18±8.19	48.26±7.03	48.11±7.07	0.364
-Inferior-Hemi	48.58±7.05	48.22±7.13	48.56±6.96	47.21±9.84	47.95±6.99	0.13
-Nasal Superior	46.18±6.27	44.79±5.96	45.31±6.1	44.85±5.34	45.11±6.37	0.523
-Nasal Inferior	45.31±5.86	44.7±5.73	45.67±5.59	43.55±7.57	44.67±5.35	0.41
-Inferior Nasal	48.72±8.12	48.02±10.11	47.59±10.23	46.25±10.53	46.88±8.27	0.128
-Inferior Tempo	53.28±10.44	53.07±11.07	53.34±11.27	51.61±12.91	52.35±10.65	0.476
-Tempo Inferior	48.02±9.48	48.55±8.54	49.01±8.69	48.92±12	49.52±8.08	0.504
-Tempo Superior	52.78±9.27	53.65±9.38	52.62±10.75	52.84±9.35	53.26±9.27	0.74
-Superior Tempo	52.11±7.78	49.98±11.45	50.7±11.27	51.53±8.49	49.55±10.27	0.097
-Superior Nasal	46.48±8.58	46.04±9.64	44.87±10.3	45.59±9.27	45.51±8.41	0.277

Figures

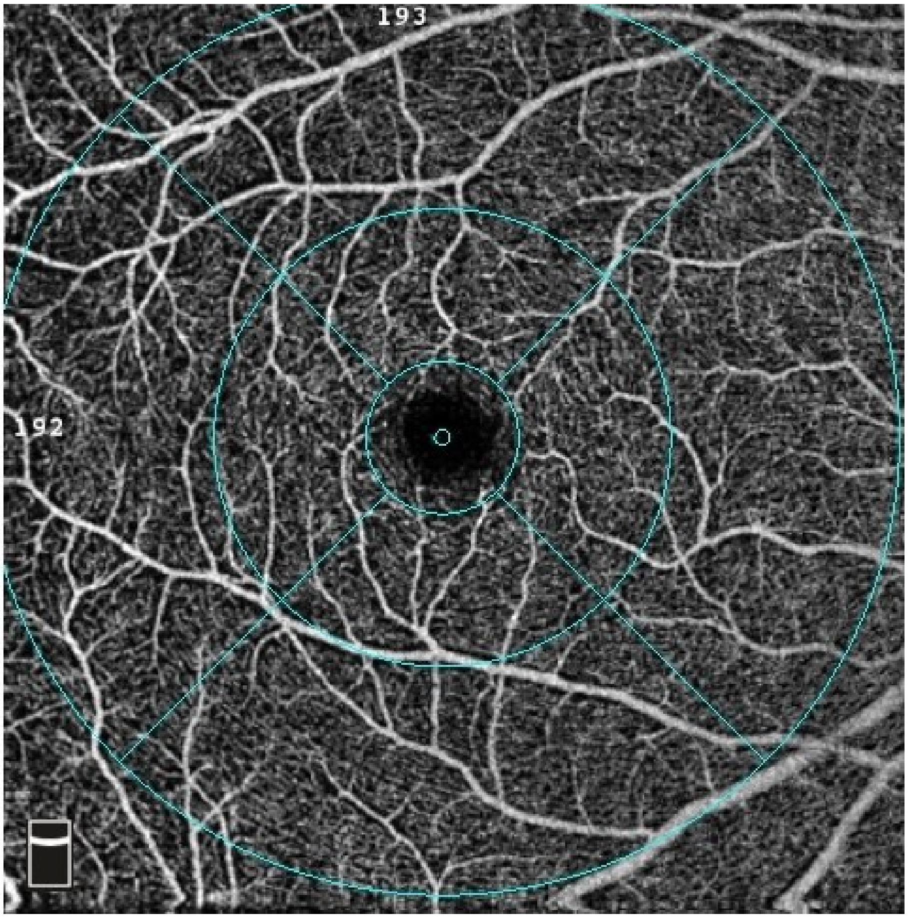

Figure 1

The scan is centered on the macula

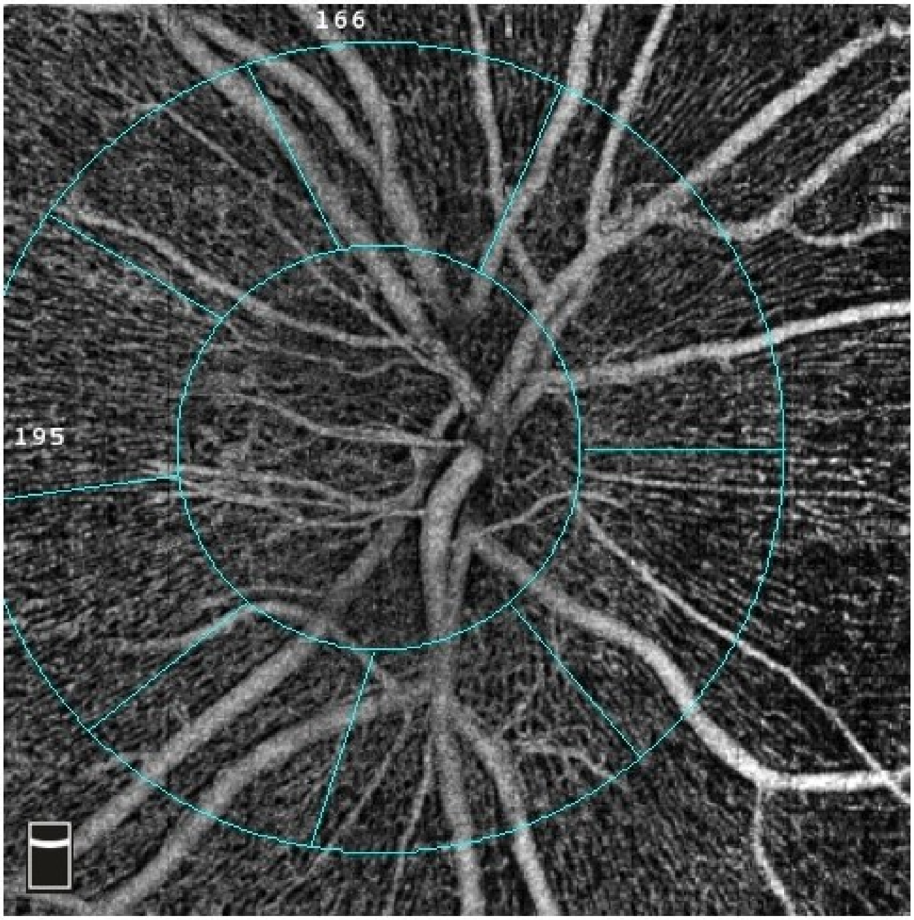

Figure 2

The scan is centered on the disc