Macular alterations after small-incision cataract surgery

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Purpose: To characterize macular edema that occurs after uneventful cataract surgery.

Setting: Centre of Ophthalmology, University Hospital, Institute of Biomedical Research on Light and Image, Faculty of Medicine, University of Coimbra, Coimbra, Portugal.

Methods: Thirty-two eyes of 32 patients had uneventful phacoemulsification with implantation of a foldable intraocular lens. Postoperatively, patients were examined at 3, 6, 12, and 30 weeks. The examinations included retinal leakage analysis (Zeiss CSLO), optical coherence tomography (Humphrey Instruments), and retinal thickness analysis (Talia Technology, Ltd.). Results were compared with those in a control group comprising healthy subjects.

Results: Increases in retinal thickness (ie, over the mean ± 2 SD in the control group) reached a maximum at 6 weeks in 13 of 32 eyes (41%), after which recovery was progressive. At 30 weeks, all eyes had good visual acuity, but 7 eyes (22%) still had macular edema. The edema was located primarily in the central macular region. Leaking sites involving the vascular areas of the macula, which indicated areas of abnormal blood–retinal barrier permeability, were a frequent finding. The number of sites remained relatively stable during the first 12 weeks (88%) and decreased to 68% at 30 weeks, indicating a trend toward recovery.

Conclusion: Macular edema after cataract surgery occurred primarily in the central region of the macula and was associated with the presence of leaking sites, which were located predominantly in the vascular regions of the central macula.

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Small-incision cataract surgery with implantation of a foldable intraocular lens (IOL) is currently the preferred technique among cataract surgeons. The procedure is efficient, and uneventful surgery is generally associated with good visual results. However, some degree of macular damage, clinically demonstrable as macular edema, continues to occur after uneventful cataract surgery.

The incidence of clinically significant cystoid macular edema (CME), an advanced stage of macular edema, has progressively decreased with the evolution from extracapsular cataract extraction (ECCE)[1–3] to phacoemulsification with posterior chamber IOL implantation.[4] The most recent reports show the incidence of clinical CME associated with some degree of visual loss is between 1% and 6%.[1] Lesser degrees of macular edema associated with variable fluorescein leakage during fluorescein angiography (angiographic CME) may occur in 19% of cases after uneventful phacoemulsification.[4] The incidence of CME is higher after cataract surgery when the posterior capsule breaks intraoperatively and is especially high after surgery complicated by vitreous loss.[2,5] Vitreous fluorometry, a more sensitive technique of measuring alterations in the blood–retinal barrier (BRB) using fluorescein, shows an even higher incidence of BRB alteration in the period immediately after cataract surgery.[6]

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The development of new methods of mapping and measuring macular edema and BRB alteration include optical coherence tomography (OCT), the retinal thickness analyzer (RTA), and the retinal leakage analyzer (RLA). In this study, we attempted to characterize macular edema that occurs after uneventful cataract surgery using these 3 new methods.

Patients and Methods:

This study evaluated 32 eyes of 32 patients with cataract who were scheduled for phacoemulsification through a small incision and implantation of a foldable IOL in the bag. Exclusion criteria included previous ocular surgery as well as ophthalmologic pathology, diabetes, and other systemic diseases that may involve the eye. Before the study, all patients were given a full explanation of the procedure and all provided informed consent. The tenets of the Declaration of Helsinki were followed.

Surgical Technique

All patients were operated on by the same surgeon (C.L.) using a standard technique. Approximately 1 to 2 hours before surgery, a combination of phenylephrine 2.5%, tropicamide 0.5%, and cyclopentolate 1% eyedrops was instilled to obtain mydriasis. Topical anesthesia comprising oxybuprocaine 1% eyedrops was then administered.

Phacoemulsification was performed using sodium hyaluronate 1% (Provisc®). The technique included an unsutured 3.2 mm clear corneal incision, an anterior capsulorhexis, hydrodissection, nuclear fragmentation using low ultrasound power, cortex aspiration, and implantation of a 3-piece hydrophobic acrylic IOL (AcrySof®, MA60BM, Alcon Laboratories) in the bag.

After surgery, the eye was patched with an antibiotic–antiinflammatory agent. The postoperative regimen included ofloxacin, timolol maleate, and dexamethasone eyedrops for the first week followed by tapering of the dexamethasone over 2 weeks.

Ophthalmologic Examinations

All the patients were examined preoperatively as well as postoperatively at 1 day and 1, 3, 6, 12, and 30 weeks. The examinations included visual acuity measurement, biomicroscopy of the anterior and posterior segments, and tonometry. Additional examinations were performed at 3, 6, 12, and 30 weeks and included evaluation of BRB permeability with the RLA (Zeiss CSLO [confocal scanning laser ophthalmoscope]), retinal thickness measurement by OCT (Humphrey Instruments), and RTA assessment (Talia Technology, Ltd.). Three patients (#8, 11, 18) refused to be examined at 30 weeks.

Retinal Leakage Analysis

The RLA quantifies localized fluorescein leakage from the retina into the vitreous across the BRB. The instrumentation and image processing have been described.[7] The analysis is based on a prototype Zeiss confocal scanning laser fluorometer. It obtains fluorometric measurements from 18 optical planes across the retina and cortical vitreous, separated from each other by 150 μm and parallel to the retina surface. After intravenous administration of fluorescein, an axial graph of equivalent fluorescein concentration in the vitreous can be obtained from any region. After fluorescein levels in the retina and choroid and plasma levels of free fluorescein are corrected for, the permeability values of the BRB to fluorescein are obtained from 1512 regions measuring 75 μm × 75 μm from a 3150 μm × 2700 μm area of the fundus. This generates a detailed map of retinal fluorescein leakage.

The RLA obtains images of the fundus and gives 3-dimensional information. Optical imaging information and fluorescence scanning measurements are obtained simultaneously. Axial graphs of the fluorescein measurements representing a volume of 75 μm × 75 μm × 2550 μm were obtained from the vitreous. These were converted into retinal leakage maps. Multiple measurements of retinal leakage were graphed using a false-color retinal leakage map, which represents the distribution of BRB alterations in any part of the total area of the posterior pole under examination. Leaking sites were identified as 75 μm × 75 μm areas of maximum percentage of fluorescein leakage occurring in 300 μm × 300 μm areas of abnormally increased permeability (ie, permeability over the mean + 2 SD of the control population).[8] Intravisit reproducibility and intervisit reproducibility of the method are ±10.2% and ±13.0%, respectively.[7]

Retinal Thickness Analysis

Retinal thickness was assessed by RTA and OCT. The RTA is a quantitative and reproducible method of evaluating retinal thickness.[9–11] The variability in the measurements obtained in normal subjects is 8%.[12] The principle of RTA is based on projecting a thin helium neon laser (543 nm) slit obliquely on the retina and viewing it at an angle in a manner similar to slitlamp biomicroscopy. The separation between the reflections (and scatter) from the vitreoretinal interface and the chorioretinal interface is a measure of retinal thickness. Nine scans are obtained covering the central 20-degree area around the fovea in the posterior pole. Each scan is composed of 10 optical cross-sections of the retina, separated by 200 μm, measuring an area of 200 μm × 200 μm. The total area scanned is 6000 μm × 6000 μm. Software version 2.11 with analysis 6.35 was used in this study.

Optical coherence tomography is a diagnostic technique that provides cross-sectional tomographs of retinal structures in vivo. Optical interferometry is used to resolve the distances

of reflective structures within the eye. It is analogous to ultrasound B-scan but has better resolution, about 10 μm in the retina.[13,14]

Low coherence light from a superluminescent diode source, operating at 840 nm (infrared light), is divided in 2 beams: 1 incident on the retina and the other incident on a translating mirror. The 2 reflected beams are recombined, and optical interference is detected by a photodiode. A computer algorithm was used to profile the inner and outer retinal boundaries for each tomogram. The retinal thickness was computed automatically from these boundaries by assuming a constant refractive index of 1.36. The reproducibility of the method in normal subjects is approximately 7%.[13] Software version A6.2 was used in this study.

Data are displayed as a numeric report and as a false-color topographic map, divided into 9 Early Treatment Diabetic Retinopathy Study–type regions. For each region, an average retinal thickness is automatically computed. In the color-coded map, bright colors such as red and white correspond to high optical reflectivity areas and dark colors such as blue and black indicate lower reflectivity areas.

Measurement Comparison Between Methods

To compare RTA and OCT areas of thickness and RLA values of alteration of BRB permeability, a new thickness map of the RTA measurements was created. To do this, the covered area for each single value on the RTA thickness map and the areas covered at the 5 different locations on the OCT map were considered and the map was computed using the values that best fit the locations covered by the OCT map.[15] For all 3 methods (RLA, RTA, OCT), 5 values were obtained from 5 retinal regions located within 2 circles: (1) a central disc area 1.0 mm in diameter, centered on the patient's fixation, which was assumed to correspond to the central fovea; and (2) a peripheral ring area between 1.0 mm and 3.0 mm in diameter and centered on the fovea. The areas were divided in 4 retinal quadrants: papillomacular, superior, temporal, and inferior.

A group of normal subjects was used as a control to obtain reference values for the 3 measurement methods. Normal threshold values were computed using the mean ± 2 SD of the reference values. Abnormally increased values were expressed as a percentage over the normal threshold values.

Statistical Analysis

Alterations in BRB permeability measured using the RLA were evaluated by determining the number of leaking sites in each of the 5 areas examined, the value of the maximum percentage of the increase over the normal mean ± 2 SD reference values, and the percentage of the area under examination that showed abnormally increased permeability values (normal ± 2 SD). Increases in retinal thickness measured by the RTA and OCT were calculated as the percentage of increase (over normal means ± 2 SD) in each of the 5 areas.

Results

The mean age of the 32 patients was 74.39 years ± 6.49 (SD) (range 57 to 92 years). There were 12 men and 20 women.

Tables 1 to 3 summarize the results. Postoperatively, visual acuity was 8/10 or better in 81% of eyes at 3 weeks, 88% at 6 weeks and 12 weeks, and 91% at 30 weeks. Visual acuity was worse than than 8/10 in 3 cases at 30 weeks because of capsule opacification. All 3 cases had a neodymium:YAG laser capsulotomy at the termination of the study, after which visual acuity improved.

Leaking sites, which indicated areas of abnormal BRB permeability, were detected in all but 1 eye. The sites were observed in all 5 regions (fovea, papillomacular, temporal, superior, inferior). The number of sites remained relatively stable during the first 12 weeks of follow-up and were present in 88% of eyes at that time. The percentage of eyes with leaking sites decreased to 68% at 30 weeks, indicating a trend toward recovery.

There were more leaking sites in the regions surrounding the central foveal zone (1000 μm in diameter), indicating they occur primarily in the superior and inferior regions of the macula above and below the fovea. They were located in the vascularized regions of the macula outside the avascular foveal zone.

Increases in retinal thickness measured with the OCT above the mean ± 2 SD of the reference group reached a maximum at 6 weeks and occurred in 13 (41%) of the 32 eyes. From 6 weeks to the end of the follow-up, there was a progressive decrease in abnormal retinal thickness values. At 30 weeks, 7 eyes (22%) had a degree of macular edema. The macular edema observed after cataract surgery was located primarily in the central macular region in the fovea throughout the study. Figure 1 shows a set of sequential examinations of patient 17.

Increases in retinal thickness measured with the RTA showed significant variability, apparently as a result of the presence of the IOL. The data are not reported here because they were considered unreliable for this type of eye with an IOL.

Discussion

This study shows that even after uneventful small-incision cataract surgery, significant alterations occur in the macula. All eyes except 1 (97%) developed localized

Table 1. Visual acuity, leaking sites, and OCT findings postoperatively.

Pt	Age (Y)	Visual Acuity				Leaking Sites on Fovea by RLA				Leaking Sites on Central Fovea by OCT			
		3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk
1	73	10/10	10/10	10/10	10/10	1	0	0	3	0	0	0	0
2	71	8/10	8/10	8/10	8/10	8	0	6	7	11	12	2	12
3	82	3/10	5/10	8/10	8/10	0	8	0	0	0	0	0	0
4	77	8/10	10/10	10/10	10/10	2	0	1	0	17	0	0	0
5	76	8/10	8/10	8/10	7/10	7	10	8	0	11	0	4	10
6	77	10/10	10/10	8/10	8/10	7	6	3	8	0	6	0	0
7	79	10/10	7/10	6/10	10/10	3	5	4	4	6	31	14	0
8	77	8/10	10/10	8/10	—	8	7	4	—	6	4	0	—
9	70	8/10	10/10	10/10	10/10	0	6	7	0	0	0	0	0
10*	75	8/10	8/10	8/10	6/10	0	4	10	5	0	0	0	0
11	75	7/10	8/10	7/10	—	1	0	4	—	0	28	0	—
12	66	10/10	10/10	10/10	10/10	6	6	7	9	0	0	0	0
13	75	10/10	8/10	10/10	10/10	0	4	0	3	0	5	0	9
14	69	8/10	10/10	10/10	10/10	4	5	3	0	0	0	0	0
15	70	8/10	10/10	8/10	8/10	2	9	11	6	0	0	0	0
16	71	10/10	10/10	10/10	10/10	3	4	8	0	22	24	24	28
17	80	10/10	10/10	10/10	8/10	7	4	5	3	0	6	0	0
18	57	8/10	10/10	10/10	—	0	6	10	—	0	0	0	—
19	75	10/10	10/10	10/10	10/10	4	7	5	6	0	2	9	6
20	73	10/10	10/10	10/10	10/10	5	8	8	5	0	0	0	0
21*	92	7/10	10/10	8/10	5/10	2	0	3	0	0	0	0	0
22	67	6/10	8/10	8/10	8/10	0	0	1	0	0	0	0	0
23	74	7/10	7/10	10/10	8/10	5	6	5	5	110	102	78	89
24	67	8/10	10/10	10/10	10/10	7	3	1	6	0	0	0	0
25	73	10/10	8/10	10/10	10/10	0	0	0	0	0	0	0	0
26*	81	2/10	4/10	6/10	5/10	7	9	9	7	12	45	4	2
27	77	8/10	8/10	8/10	8/10	0	7	5	8	0	0	0	0
28	70	6/10	7/10	10/10	8/10	0	0	0	0	6	0	8	6
29	81	10/10	8/10	10/10	10/10	3	8	6	7	0	10	0	14
30	80	7/10	8/10	7/10	8/10	0	5	9	5	0	0	0	0
31	62	10/10	10/10	6/10	10/10	3	0	0	0	0	6	2	0
32	65	10/10	10/10	10/10	8/10	6	7	2	10	0	0	0	0

OCT = optical coherence tomography; Pt = patient; RLA = retinal leakage analyzer
*Capsule opacification

BRB alterations at some time during the follow-up. Localized increases in retinal thickness, indicating macular edema, were present in 41% of eyes.

The localized BRB alterations, well documented by the leaking sites identified with the RLA, involved the entire macular area but were located primarily in the vascularized retina around the avascular foveal zone. The retinal leakage maps showed that most sites are probably located in the perifoveal retinal vessels.

The location of BRB alteration associated with macular edema after cataract surgery is controversial. Experimental studies by Tso and Shih[16] indicate that both the inner and outer BRB are altered. In this study, the higher number of leaking sites in the vascularized regions of

Table 2. Number of leaking sites by area.

	Superior				Inferior				Papillomacular				Temporal				Fovea			
Pt	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk
1	9	0	0	9	0	0	0	4	4	0	0	5	7	0	0	10	1	0	0	3
2	6	0	14	8	0	0	0	6	0	0	3	8	15	2	17	5	8	0	6	7
3	2	7	0	13	0	0	0	4	0	5	0	12	6	2	0	7	0	8	0	9
4	10	6	5	0	2	0	0	0	0	0	3	0	2	1	10	0	2	0	1	0
5	12	11	9	0	6	4	8	0	12	10	6	0	6	6	11	0	7	10	8	0
6	0	7	7	12	0	4	0	11	0	4	5	9	0	7	6	14	7	6	3	8
7	0	7	4	14	0	1	5	1	0	1	3	11	0	4	2	9	3	5	4	4
8	11	11	12	—	1	5	6	—	6	12	10	—	8	10	12	—	8	7	4	—
9	0	8	14	0	0	5	2	0	0	10	6	0	0	14	15	0	0	6	7	0
10	3	6	10	0	0	1	1	0	4	7	5	6	0	1	0	1	0	4	10	5
11	0	1	4	—	0	1	5	—	0	3	4	—	0	2	5	—	1	0	4	—
12	10	11	10	15	8	3	7	4	8	13	7	9	12	10	15	15	6	6	7	9
13	0	8	0	9	0	4	0	4	0	1	0	8	0	17	0	12	0	4	0	3
14	12	8	15	0	2	4	5	0	5	8	7	0	10	15	7	0	4	5	3	0
15	7	3	14	15	0	4	5	5	10	10	9	5	4	17	15	12	2	9	11	6
16	8	6	6	0	0	5	4	0	2	6	8	0	2	6	7	0	3	4	8	0
17	6	13	15	13	4	0	5	0	0	5	6	5	18	4	12	17	7	4	5	3
18	0	7	13	—	0	0	0	—	0	13	2	—	0	2	2	—	0	6	10	—
19	9	10	6	11	2	0	3	8	3	5	9	7	8	3	6	7	4	7	5	6
20	7	4	9	10	0	1	6	8	6	10	5	11	12	10	10	2	5	8	8	5
21	10	5	13	1	3	0	0	0	5	0	3	0	10	4	9	0	2	0	3	0
22	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
23	12	10	7	8	4	6	4	4	1	5	0	0	13	7	1	4	5	6	5	5
24	10	0	9	12	4	0	0	2	8	0	9	7	13	2	3	13	7	3	1	6
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	4	11	8	11	1	5	4	4	3	0	3	2	9	10	17	16	7	9	9	7
27	0	10	9	10	0	5	2	2	0	9	10	7	0	9	10	8	0	7	5	8
28	0	0	0	0	0	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0
29	2	2	8	10	4	3	2	6	0	1	10	6	3	2	14	19	3	8	6	7
30	1	4	5	11	0	2	7	5	0	3	0	12	0	2	11	4	0	5	9	—
31	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	3	0	0	0
32	9	16	5	16	6	6	0	0	10	10	7	5	12	19	6	7	6	7	2	10

Pt = patient

the macula suggests significant involvement of the retinal vessels. However, the presence of leaking sites in the avascular foveal zone indicated that the retinal pigment epithelium is also involved, although to a lesser degree.

Optical coherence tomography demonstrated the presence of localized areas of abnormally retinal thickness; that is, macular edema in 13 of 32 eyes. The increases in retinal thickness were more predominate in the central foveal area. In 4 eyes, the increase was still present at the end of the study (30 weeks after cataract surgery). This was higher than 10% above the mean + 2 SD in the normal reference group. The presence of cyst-like structural alterations in the retina was observed in only 2 (6%) of these 4 eyes.

Macular edema is a main cause of reduced visual acuity after cataract surgery. The true incidence, how-

Table 3. OCT percentage increase by area.

	Superior				Inferior				Papillomacular				Temporal				Fovea			
Pt	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk	3 Wk	6 Wk	12 Wk	30 Wk
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	12	2	12
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	4	10
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
7	0	17	0	0	0	18	0	0	0	14	0	0	0	30	6	0	6	31	14	0
8	0	0	0	—	0	0	0	—	0	0	0	—	0	0	0	—	6	4	0	—
9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	8	0	—	0	3	0	—	0	0	0	—	0	0	0	—	0	28	0	—
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	9
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	24	24	28
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
18	0	0	0	—	0	0	0	—	0	0	0	—	0	0	0	—	0	0	0	—
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	9	6
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	44	32	22	31	59	56	28	38	11	10	5	2	62	48	32	53	110	102	78	89
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	5	0	0	0	21	0	0	0	3	0	0	12	45	4	2
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	8	6
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	14
30	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Pt = patient

ever, varies according to the examination techniques used and the clinical significance attributed to it.

If only CME associated with reduced visual acuity is considered, the incidence appears to be approximately 2%.[3] In our study, visual acuity generally remained at 8/10 or better. The 2 eyes with larger increases in retinal thickness and cystoid changes seen with OCT 30 weeks after surgery had a final visual acuity of 10/10.

Angiographic macular edema, identified by the presence of hyperfluorescent spots on fluorescein angiography after cataract surgery, is reported to be a relatively frequent finding, with an incidence after small-incision cataract surgery of approximately 20%.[4]

Finally, in a study using vitreous fluorometry, a more sensitive method for detecting BRB alterations, abnormal leakage of fluorescein was present in the poste-

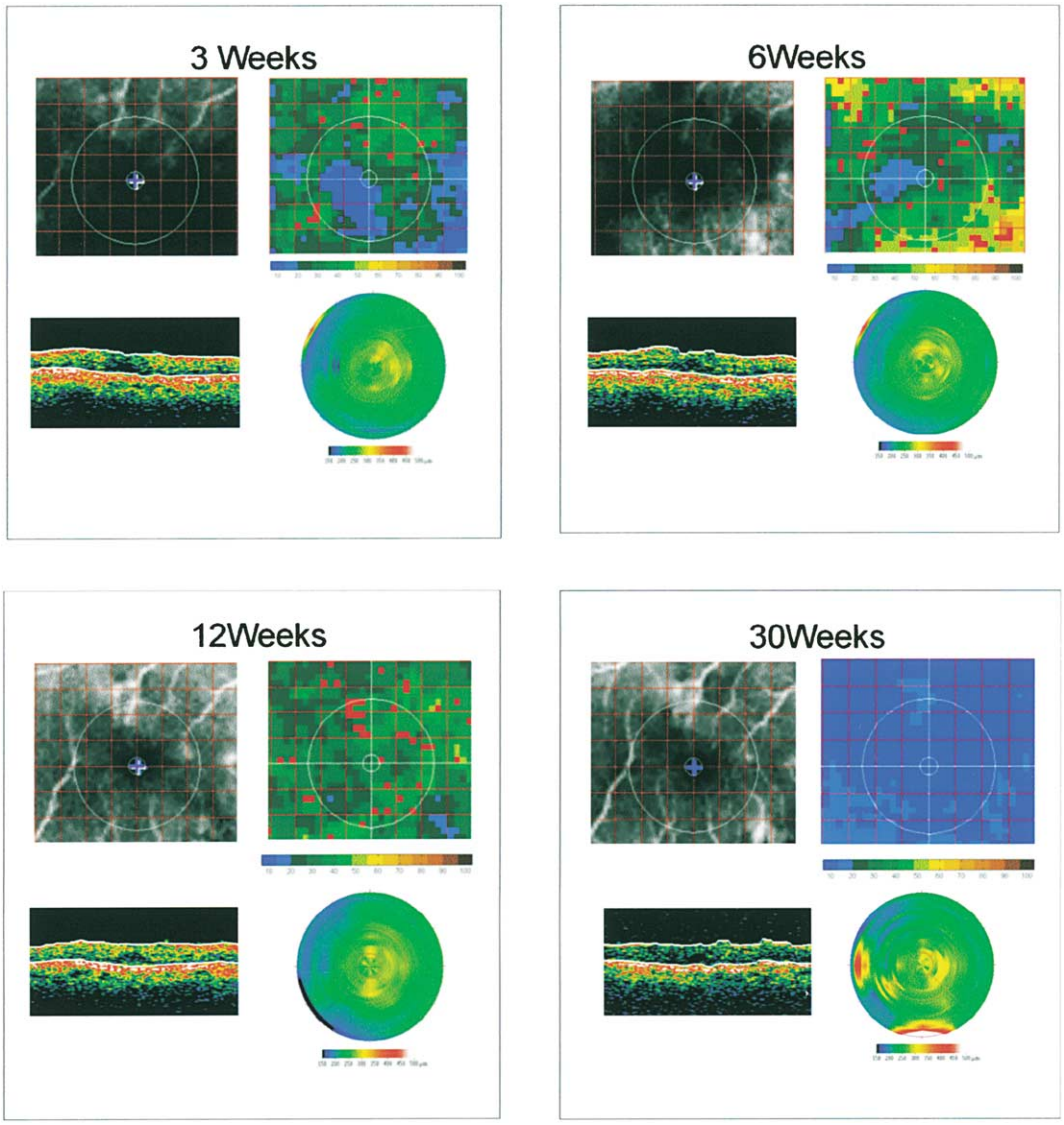

Figure 1. (Lobo) Images taken of patient 17 over time. In each set, the top left is an angiographic image with the RLA, the top right is the RLA color-coded map of BRB permeability indices showing the leaking sites ($\times 10^{-7}$ cm/s), the bottom left is an OCT tomography image, and the bottom right is an OCT color-coded map of retinal thickness (μm).

rior pole in 68% of eyes that had uneventful cataract surgery.[6]

In our study, the RLA identified leaking sites in all but 1 of the eyes examined. This extremely high occurrence of BRB alterations (97%) that apparently involve the retinal vasculature may be a result of the age of the patients who have cataract surgery and may indicate abnormal retinal vasculature in eyes with advanced senile cataract, which may be associated with the aging process.

Although BRB alteration appears to be an almost constant finding after uneventful cataract surgery, increases in retinal thickness are clearly less frequent in aging eyes. The alterations in the BRB remained relatively stable, even 30 weeks after surgery, whereas the increases in retinal thickness reached a maximum 6 weeks after surgery and decreased progressively afterward. At the end of the study, 30 weeks after surgery, only 9 (28%) of the 32 eyes had some degree of macular edema. These findings agree with the observations of Sourdille and Santiago,[17] who found postoperative increases in retinal thickness using OCT in 11 (27%) of 41 eyes having uneventful small-incision cataract surgery and IOL implantation.

In our study, the increase in retinal thickness after cataract surgery, measured by OCT, was located primarily in the central foveal area. In contrast, the alteration of the BRB, identified by leaking sites, was located primarily in the vascularized regions around the fovea. It appears from these findings that the increased fluid that penetrates the retina as a result of alteration of the perifoveal retinal vasculature accumulates in the fovea. This is probably because there is more space available and less tissue tension, which are structural characteristics of the foveal anatomic architecture.[17]

We found it interesting that the BRB alteration and macular edema reached a maximum 6 weeks after surgery, with progressive recovery afterward, but that they maintained a degree of chronicity. Thirty weeks after surgery, approximately 50% of eyes showed some degree of fluorescein leakage and 30%, some degree of macular edema. These alterations are present in the retina in association with good visual acuity, measured using the Snellen chart. More sensitive means of evaluating visual acuity may demonstrate changes indicating deficits in visual function. Further research may provide an opportunity for improving visual results after cataract surgery.

At present, the actual clinical significance of BRB alterations and retinal thickness after uneventful cataract surgery is not clear. Cataract extraction is the most frequent ophthalmic surgery, and the true long-term effects on retinal function are not yet understood. These retinal changes may be the result of remaining subclinical inflammation or may simply indicate poor recovery of eyes with aging retinal vasculature. In any case, the alterations need further investigation with the goal of developing improved therapies to prevent long-term consequences. An abnormal increase in BRB permeability may create conditions under which there is local accumulation of vascular growth factor and that ultimately lead to the development of abnormal retinal neovascularization.

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