

Optical Coherence Tomography Findings in Highly Myopic Eyes following Cataract Surgery

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Abstract

Purpose: To study optical coherence tomography (OCT) findings in high myopic patients with the history of uncomplicated cataract surgery

Methods: The sample included 34 eyes of 24 highly myopic patients with an axial length (AL) of 26 mm or more and a spherical equivalent (SE) of 8.0 diopter (D) or more who had uncomplicated phacoemulsification cataract surgery. OCTs were done in multiple sections around optic disc and fovea.

Results: The mean age of the 24 patients was 58.9±12.9 years, and the mean SE was 14.5±5.8 D. The mean time gap between cataract surgery and OCT studies was 15.6±18 months, and the mean AL was 29.1±2.1 mm. The most common OCT findings were vascular microfolds (67.6%) and paravascular retinal cysts (64.7%). Vascular microfolds were found significantly associated with age. Internal limiting membrane (ILM) detachment was significantly associated with gender (female group). Peripapillary choroidal cavitation had a significant direct association with postoperative elapsed time in all ages.

Conclusion: Vascular microfolds and paravascular retinal cysts are the most common pathologies in myopic (aphakic and pseudophakic) persons. ILM detachment is more common in females. Peripapillary cavitation incidence is associated with postoperative elapsed time.

Keywords: Optical Coherence Tomography, Pathologic Myopia, Cataract Surgery

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Introduction

In recent years, structural studies of the retina have been made easier with the introduction of optical coherence tomography (OCT), and new observations concerning vitreoretinal changes have been discussed in patients with high myopia which are not detectable by simple conventional examination methods.

Most studies in this regard have been conducted on phakic patients,^{4,7} and previous studies showed that myopic changes progressed with age.^{4,7} The purpose of our study was to study OCT findings in this particular group of patients, who were aphakic or pseudophakic cases.

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Methods

The cases in this study were selected from high myopic patients. Inclusion criteria were a minimum axial length (AL) of 26 mm, or a minimum spherical equivalent (SE) of 8.0 diopters (D), and having undergone uncomplicated phacoemulsification with or without intraocular lens (IOL) implantation more than 2 months before our investigation. Patients with systemic disease or surgery that could affect the retina, were excluded from the study.

Institutional Review Board (IRB)/Ethics Committee approval and informed consent was obtained for each patient. All patients had complete examinations with the slit-lamp, biomicroscopic funduscopy with 90 D lens indirect ophthalmology with 20 D lens. ALs were measured in millimeters using the IOLMaster (Carl Zeiss Meditec). Other information including patient age, gender, refraction, date of cataract surgery, and results of funduscopy examinations were collected in designated forms. Fundus photography was done (Topcon TRC-50EX, Topcon Corporation, Tokyo, Japan, and OCT by OTI, Inc. Toronto, Canada or Spectralis Heidelberg Retinal angiograph/OCT; Heidelberg Engineering, Heidelberg, Germany). On the same day OCT was performed.

OCTs were done by a single experienced vitreoretinal specialist. The examined area included the center of the optic nerve up to 6.0 mm from the center of optic nerve head in the nasal and temporal direction and 3.0 mm in the superior and inferior direction. The examiner changed the target light location during OCT pictures acquisition to evaluate the entire surface mentioned here. All abnormal observations were documented and recorded in OCT and fundus photographs. These findings included retinoschisis, paravascular retinal cysts and paravascular lamellar hole, peripapillary intrachoroidal cavitation (also known as peripapillary detachment in pathologic myopia [PDPM]), tractional internal limiting membrane (ILM) detachment, vascular microfolds, macular hole (lamellar and full thickness), and choroidal neovascular membrane.

Our findings are presented here. All patient's data was entered and analyzed using

the SPSS software for Windows version 16.0 (SPSS Inc, Chicago, Illinois, USA) with Mann-Whitney U test and P value equal or smaller than 0.05 presumed to be significant.

Results

A total of 34 eyes of 24 patients were studied. The gender distribution was equal, and 60.6% of the studied eyes were the right eyes. The mean age of the patients was 58.9 ± 12.9 (range, 33 to 77) years. Mean SE in these eyes was 14.5 ± 5.8 (range, 5.75 to 22.75) D. The mean time elapsed after cataract surgery was 15.5 ± 18 (range, 2 to 77) months. Mean AL was 29.1 ± 2.1 mm (range, 24.5 to 32.5). Only one eye had had clear lens extraction and was aphakic; 97% of cases had IOLs.

Slit-lamp examination results are as follows:

Posterior staphyloma in 24 eyes (70.5%), posterior vitreous detachment in 25 eyes (73.5%) and a history of YAG laser capsulotomy in 2 eyes (5.8%). The prevalence rates of different OCT findings are summarized in table 1. Posterior retinal detachment was not observed in any patient. Since the age distribution was not normal, associations between age and these findings were tested with the Mann-Whitney U test; only vascular microfolds were significantly more prevalent in older ages ($P=0.05$) (50.8 years vs. 62.6).

The mean age in the two gender groups 62 ± 12.4 years and 56 ± 13.1 years in women and men, respectively was not significantly different ($P=0.176$). In the multivariate model with the variables of age and gender, vascular microfolds were significantly associated with age. In the presence of age and gender, the prevalence of ILM detachment was significantly higher in women. The time elapsed after cataract surgery was not significantly associated with the prevalence of any of the studied findings except peripapillary choroidal cavitation ($P=0.018$). By including the age, peripapillary choroidal cavitation showed a significant and direct correlation with the time elapsed after cataract surgery (after eliminating the effect of age).

Some of those findings are shown here in figures 1 and 2 with short explanation.

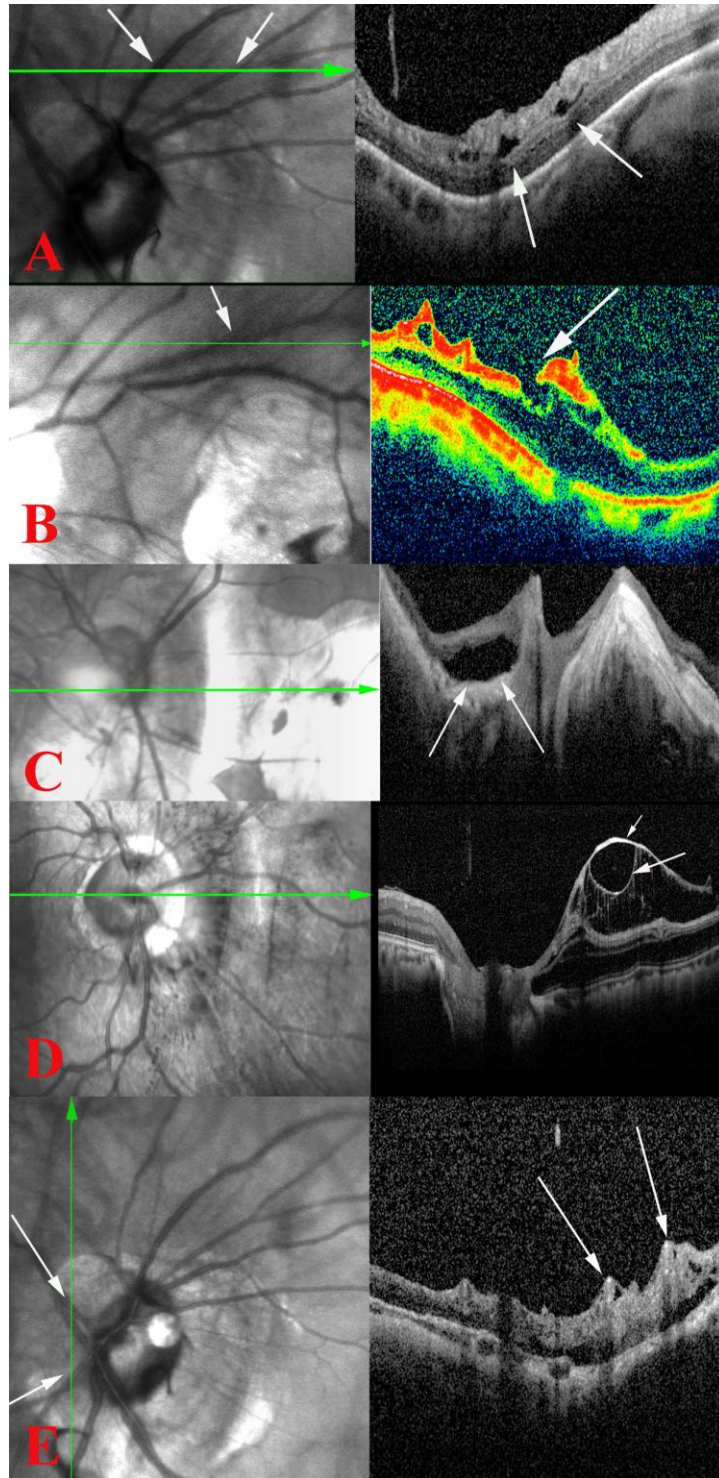


Figure 1. A: This part shows perivasculopathy cysts (white arrows) as low reflective hollow spaces in middle retinal layer which usually located near large retinal vascular compartments. B: Lamellar hole (white arrows) in this figure may be the consequence of unroofed paravasculopathy (peripapillary detachment in pathologic myopia) as hollow, low backreflective spaces adjacent to optic disc. C: This part shows peripapillary intrachoroidal cavitation (peripapillary detachment) as hollow, low backreflective spaces adjacent to optic disc. D: This figure show peripapillary retinoschisis accompanied with ILM detachment (large arrow) and tractional epiretinal membrane over it (small arrow). Outer retinal layer show schisis pattern and dehiscence. E: Multiple vascular microfolds in this picture represented as tented elevations of retina across vascular roots.

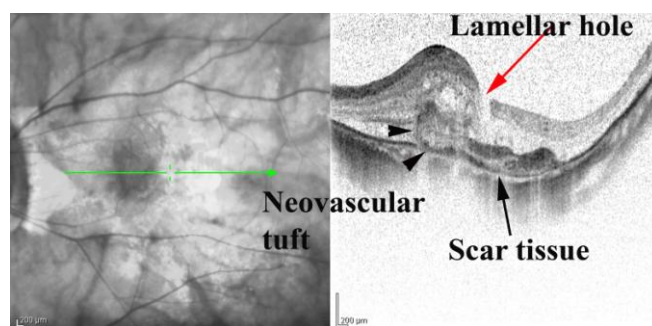


Figure 2. A myopic person with subfoveal choroidal vascular membrane. Large black arrows show the temporal margin of neovascular tissue which seems to be minimally active. The blurred nasal margin indicated considerable neovascular activity in this area (arrow heads). Outward displacement of inner retina result in cleft formation and lamellar hole creation (red arrow).

Table 1. The percentage of various optical coherence tomography findings in high myopic persons in previous past studies and comparison to our study

| OCT findings | Our study, Number of cases (%) | Other studies (%) |
|---------------------------------------|--------------------------------|---------------------------|
| Macular hole | 5.9 (2) | 6.26 ^{10*} |
| Para vascular microfold | 67.6 (23) | 20-44.6 ^{4,11} |
| Paravascular retinal cyst | 64.7 (22) | 1.5-49.5 ^{4,11} |
| Macular retinoschisis | 11.8 (4) | 5-20 ^{5,11} |
| Posterior retinal detachment | 0 (0) | 5.2-18.5 ^{11,12} |
| Retinoschisis | 23.5 (8) | 13.5 ⁴ |
| Internal limiting membrane detachment | 47.1 (16) | 2.4-6 ^{4,6} |
| Peripapillary choroidal cavitation | 26.5 (9) | 5 ⁴ |
| Paravascular lamellar hole | 23.5 (8) | 26.8 ¹¹ |
| Epiretinal membrane | 50 (17) | 46.4 ⁵ |
| Lamellar macular hole | 17.6 (6) | 4.8 ⁵ |
| Choroidal neovascular membrane | 5.9 (2) | 0.2 ¹³ |

*: This study included non-symptomatic phakic patients with very high myopia (-14 to -32 Diopter)
OCT: Optical coherence tomography

Discussion

The safety of procedures such as clear lens extraction in high myopic cases has always been a matter of debate,¹⁻³ and it is still not clear whether surgical procedures can affect the vitreous and the vitreoretinal interface, and cause ocular complications after cataract surgery or not. Most studies concerning OCT findings in high myopia have mainly focused on phakic eyes.⁴ Some studies have included both phakic and aphakic eyes in their sample.⁹ A summary of study findings, including the present one, is presented in table 1.

According to this table, the prevalence rates of findings that lead to impaired vision in myopic patients, such as macular retinoschisis, macular holes, posterior retinal detachment, and choroidal neovascular membrane were not different, or even lower, in our patients who had all undergone cataract surgery, compared to other reports where mostly phakic patients were studied.

Findings such as ILM detachment showed a higher prevalence rate in our study. This could be attributed to differentiating detached

ILM from epiretinal membranes or condensed posterior cortical vitreous, because there is great overlap in the diagnostic features of ILM detachment and epiretinal membranes. The differentiation is based on Müller cell columns, specially when traction over the macula is observed. It seems that the epimacular traction membrane, which is seen adjacent to the macula, is the detached ILM, but it is not visible with some OCT devices due to the absence or extreme thinning of Müller cell columns. Furthermore, excessive traction of the epiretinal membrane may sometimes lead to bridge formation over the retina, which is very difficult to distinguish from Müller cell columns due to retinal thinning (Figure 3).

In high myopic patients posterior cortical vitreous is multi-layered and firmly attached to retina and make diagnosis and differentiation of ILM detachments more difficult. The epiretinal membranes observed in this study were mostly appeared as noticeable layer over the inner surface of the retina, and at the same time, ILM could be distinguished as well at the same cut. Therefore, misdiagnosis or overdiagnosis of epiretinal membrane is less likely where there is bridging over the macula (Figure 3).

The most common finding in our patients was vascular folds (67.6%); this result is different from that reported by Sayanagi et al in 2005⁷ who stated a much lower prevalence rate of 2.9%, although their patients were older on average. This contrast may be due to different methodologies and the smaller investigated area of the retina (the scanned area was 5.65

mm long), or less familiarity with this finding in OCT. However, more recent papers have given higher prevalence rates ranging between 20 and 44.6%.^{4,11} The prevalence of paravascular cysts, which is observed with advanced vascular microfolds, was similar, and comparable to the rate of 49.5% reported by Shimada et al.¹¹ In our study, older age seems to have a role in the increased prevalence of vascular microfolds, and can be attributed to degenerative changes of the retina.

Peripapillary choroidal cavitation was first introduced as PDPM by Freund et al¹⁴ in 2003. Initially, it seemed to be a limited retinal pigment epithelium (RPE) detachment, but later they found that it was probably due cavity formation in the external part of the RPE and in the choroids around the optic nerve,¹⁵ which can cause glaucomatous field defects as well (Figure 1 part C).

The prevalence of PDPM was 4.9% in the study by Shimada et al¹⁵ but was observed in 11% of the cases in their 2007 study.¹⁶ This defect is probably due to an increase in myopia and the size of the globe, which subsequently leads to the retraction and detachment of the external layers of the retina around the optic nerve. In our study, the prevalence of this finding was directly correlated with the SE and time interval after surgery; in fact, it was the only finding associated with the time interval after cataract surgery. This suggests that cataract surgery can cause changes around the optic nerve in myopic patients that appear over time.

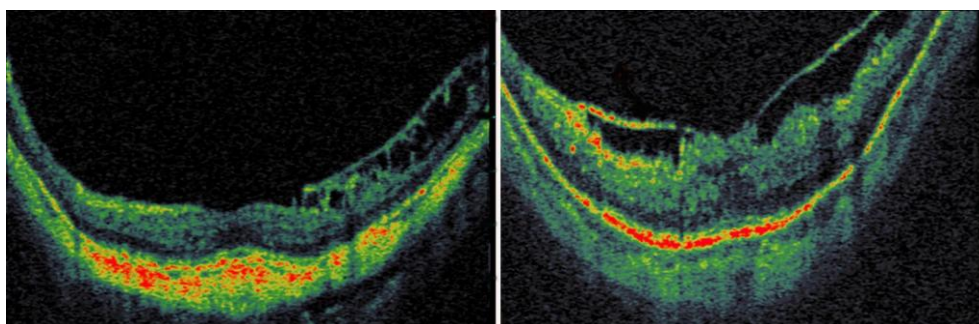


Figure 3. Distinction between internal limiting membrane detachment and epiretinal membrane. Left: High reflectance in the paramacular area on the innermost retinal layer, which consists of a thickened internal limiting membrane detached from the retina and visible Müller cell column bridges. Right: thick epiretinal membrane with multiple attachment points on the macula and tractional changes

Vision threatening findings, such as posterior retinal detachment and foveoschisis are less common in our group and it is likely that those with serious retinal problems and no potential for improved vision were not scheduled for cataract surgery and excluded.

To mention the limitations, it must be noted that this is a case series study, and stronger evidence can be gathered through prospective case-control studies, with control group of patients with intact lens, although it may be

difficult to find non-cataractous high myopic patients in this age range.

Conclusion

In our investigation vascular microfolds and paravascular retinal cyst are the most frequent findings in the high myopic patients. Prepapillary cavitations in mostly seen in older persons and ILM was more frequent in females.

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