Imaging Capsular Block Syndrome with Anterior Segment Optical Coherence Tomography

Kapsüler Blok Sendromunun Ön Segment Optik Koherens Tomografi ile Görüntülenmesi

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ABSTRACT

Purpose: To evaluate patients prediagnosed with capsular block syndrome (CBS) using slit-lamp adapted anterior segment optical coherence tomography (SL-OCT) prospectively.

Materials and Methods: The eyes of the patients with decreased vision following phacoemulsification and intraocular lens (IOL) implantation prediagnosed as capsular block syndrome were included. Following ophthalmological examination with pupillary dilation, SL-OCT imaging was performed.

Results: The study included 17 eyes of 17 cases with late onset CBS. The mean period of time between cataract operation and CBS diagnosis was 66.5± 31.6 months (range 5 to 120 months). The interspace between posterior surface of the IOL and posterior capsule was hyporeflective in six cases and hyperreflective in other cases. The mean posterior displacement of posterior capsule was 1.02 ± 0.74 mm (range 0.35 to 2.17 mm) at the deepest location. Except for three cases all were treated with Neodymium:YAG (Nd:YAG) laser posterior capsulotomy.

Conclusion: Late-onset CBS can be seen years after phacoemulsification surgery and is thought to be occurred by the liquefied retained cortical material. Also, this condition may be misdiagnosed as IOL opacification. SL-OCT is a useful and supportive method in the demonstration and differential diagnosis of CBS.

Key words: Capsular Block Syndrome, Anterior Segment Optical Coherence Tomography, Phacoemulsification, Nd:YAG laser capsulotomy.

ÖZ

Amaç: Kapsüler Blok Sendromu (KBS) ön tanısı konulan olguların biyomikroskop ile birleştirilmiş Ön Segment Optik Koherens Tomografisi (ÖS-OKT) ile prospektif olarak değerlendirilmesi.

Gereç ve Yöntemler: Fakoemülsifikasyon ve göz içi lensi (GİL) implantasyonu sonrası görmede azalması olan, KBS ön tanısı koyulan olan hastalar çalışmaya dahil edildi. Pupilla dilatasyonu öncesi ve sonrası yapılan oftalmik muayene ardından ÖS-OKT ile ön segment görüntülemesi yapıldı.

Bulgular: Çalışma geç başlangıçlı KBS olan 17 hastayı kapsamaktadır. Katarakt ameliyatı ile KBS tanısı arasında geçen süre ortalama 66.5 ± 31.6 ay (dağılım 5 ve 120 ay) idi. Arka kapsülün posteriorda yer değişimi en derin noktada 1.02 ± 0.74 mm (dağılım 0.35 ve 2.17 mm) olarak ölçüldü. GİL arka yüzeyi ve arka kapsül arasındaki boşluk 6 olguda hiporeflektif, diğerlerinde hiperreflektif olarak izlendi. Üç vaka dışında tamamına Neodymium:YAG laser arka kapsulotomi uygulandı.

Sonuç: Geç dönem KBS, fakoemülsifikasyon ameliyatından yıllar sonra görülebilmekte ve likefiye korteks materyaline bağlı olduğu düşünülmektedir. Aynı zamanda, bu durum GİL'in opaklaşması olarak yanlış tanı alabilir. ÖS-OKT, KBS'nin gösterilmesi ve ayırıcı tanısında faydalı destekleyici bir görüntüleme yöntemidir.

Anahtar Sözcükler: Kapsüler Blok Sendromu, Ön Segment Optik Koherens Tomografisi, Fakoemülsifikasyon, Nd:YAG laser kapsulotomi.

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INTRODUCTION

Capsular Block Syndrome (CBS) was first reported, as a distention of the capsular bag and accumulation of a liquefied milky (lactocrumenasia) material within the capsular bag between the posterior capsule and posterior chamber IOL. It is thought to result from adherence of the continuous curvilinear capsulorhexis (CCC) border to the anterior intraocular lens (IOL) surface following phacoemulsification with posterior chamber IOL implantation.[1-3] This syndrome was named as CBS by Masket in 1993.[4] Miyake et al established a classification according to the time of onset: Intraoperative, early postoperative and late postoperative CBS.[5] Kim et al proposed a new classification of CBS based on pathogenetic origin as noncellular, fibrotic and inflammatory.[6]

Classically, the patient with CBS, presents with decrease of vision associated with blockage of optical axis, refractive changes due to movement of IOL and a shallow anterior chamber, and elevation of intraocular pressure (IOP). Nevertheless, late-onset CBS lack these features. High IOP is mostly seen in early onset CBS. Late-onset CBS, one month or later after cataract surgery, may be associated with decreased visual acuity, myopic or hyperopic shifts deriving from the displacement of the iris-lens diaphragm and decreased anterior chamber depth. Late-onset CBS may not be recognized until best-corrected visual acuity (BCVA) was decreased significantly. [7] Imaging the morphological changes of the anterior segment in CBS can be done by different techniques such as ultrasound biomicroscopy (UBM), Scheimpflug imaging and anterior segment optical coherence tomography (AS-OCT).[8-11] Slit-lamp optical coherence tomography (SL-OCT) is a slit-lamp adapted time-domain system employs a noncontact low coherence interferometry that obtains high resolution image.[12]

Neodymium: yttrium-aluminum-garnet (Nd: YAG) laser capsulotomy can be used to treat late-onset CBS. Usually, dense opaque substance and severe expansion of the posterior capsule make laser capsulotomy difficult. Post laser vitreous floaters, cystoid macular edema, and retinal detachment are the other risks. The surgical interventions can be an alternative.

In this study, we analyzed the morphologic features in 17 eyes with the late onset CBS pre-diagnosed with SL-OCT (Heidelberg Engineering, GmbH, Heidelberg, Germany). Moreover, measured the depth and width of distended capsular bag by using digital scale of SL-OCT to make the differential diagnosis.

MATERIAL and METHODS

Patients with a complaint of decreased vision following an uneventful cataract surgery performed with phacoemulsification technique were involved. The patient population was selected from an ophthalmology clinic prospectively between October 2012 - March 2015 were included. Patients with intraoperative complications such as posterior capsule opening, inappropriate insertion of the posterior chamber IOL, radial tearing of continuous curvilinear capsulorhexis were excluded. We collected the data from 17 pseudophakic eyes of 17 patients and evaluated with SL-OCT. The complete medical and ocular history was taken (Table 1).

The refractive status, visual acuity and intraocular pressure values were documented. Biomicroscopic examination of the anterior segment and dilated fundus examination were performed. SL-OCT were used for further evaluation of biomicroscopically suspected CBS cases.

SL-OCT uses a light source of a super luminescent diode with a 1310 nm wavelength. The axial resolution is approximately 75µm. The scanning width is 15.0mm and depth is 7.0mm with a scanning speed of 200 Hz. The sample arm and the scanning module are integrated into the projected slit of a standard clinical slit lamp, which enables the exact adjustment of OCT infrared light to the anterior segment structures to be examined. The final image is a grayscale 2-dimensional representation in a cross-sectional plane.[12]

After the documentation of anterior segment images, we measured the depth and width of distended capsular bag by using digital scale of SL-OCT. In 14 eyes Neodymium Yttrium-Aluminium-Garnet (Nd:YAG) laser was performed in order to allow the liquefied material drain out of the distended capsular bag. Then we re-evaluated the refractive status, visual acuity of the eyes and documented the relaxed, emptied capsular bag and also post-YAG measurements were made by using the digital scale of SL-OCT.

All patients gave informed consent. The study was conducted in compliance with the principles of the Declaration of Helsinki and complies with the policies of the local institutional review board.

RESULTS

Seventeen eyes (11 right, 6 left) of 17 patients (11 female, 6 male) with late onset CBS were included in the study. Mean age of patients was 73.05± 8.1 years (range 57 to 86 years). A slowly progressive decrease of visual acuity in all cases was observed. The mean period of time between cataract operation and CBS diagnosis was 66.5± 31.6 months (range 5 to 120 months). In biomicroscopic examination, a space between the posterior capsular surface, an accumulation of a transparent or white milky substance between the IOL and posterior capsule was seen. The interspace between posterior surface of the IOL and posterior capsule was hyporeflective in six cases and hyperreflective in other cases on SL-OCT. Using the digital scale of SL-OCT, mean capsular distension

Table 1. *Data summary of 17 patients with late onset CBS.*

Case number	Gender	Age (years)	OD/OS	Time of onset postoperatively	IOL*- PC** distance	Nd:YAG****	Pre - YAG BCVA"	Pre - YAG Refraction (SE"")	Pre - YAG BCVA	Post - YAG Refraction (SE)
1	F	75	OD	5 months	2.173mm	-	0.7	-0.625	1.0 †	1.375
2	F	79	OD	25 months	1.995mm	+	0.1	-0.50	0.3	1.375
3	F	83	OD	60 months	0.401mm	+	0.3	-0.25	1.0	1.00
4	F	79	OS	96 months	1.261mm	+	0.7	-1.375	0.9	-0.50
5	F	80	OD	108 months	0,565mm	+	0.7	0.125	0.9	1.375
6	M	66	OS	84 months	0.266mm	-	0.8	1.00	1.0	1.00
7	F	86	OD	120 months	0.427mm	+	0.7	-0.25	1.0	-0.25
8	F	77	OD	36 months	2.1mm	+	0.6	-0.50	1.0	1.50
9	F	82	OD	72 months	0.54	+	0.2	-0.25	0.4	0.50
10	F	65	OD	83 months	0.501	+	0.3	-0.50	1.0	-0.25
11	F	69	OS	48 months	1.232	+	0.6	-2.25	0.9	-0.50
12	F	57	OS	96 months	1.45	+	0.7	-0.50	0.9	1.00
13	M	60	OD	24 months	0.266	-	0.8	1.00	0.8	1.00
14	F	80	OD	82 months	2.18	+	0.8	-0.625	0.8	1.375
15	M	70	OD	36 months	0.345	+	0.5	0.50	0.8	-0.25
16	M	65	OS	84 months	2.35	+	0.2	-0.75	0.7	-0.25
17	M	69	OS	72 months	0.35	+	0.3	-1.50	0.6	-0.50

† Case 1, 6 and 13 were not treated with Nd:YAG laser capsulotomy, therefore, table includes the follow-up values.
*IOL: Intraocular Lens
** PC: Posterior capsule
***SL_OCT: Slit Lamp Optical Coherence Tomography
****Nd:YAG: Neodymium-doped Yttrium Aluminum Garnet Laser Capsulotomy
"BCVA: Best Corrected Visual Acuity (in Snellen Chart)
""SE: Spherical Equivalent
OD = oculus dexter
OS = oculus sinister

depth was measured as 1.02 ± 0.74 mm (range 0.35 to 2.17 mm) (Figure 1 a-d).

Intraocular pressure was 15 ± 3,3 mm Hg (range 8-21 mm Hg). Except for three cases all patients were treated with Nd:YAG laser posterior capsulotomy. During Nd-YAG laser posterior capsulotomy procedure, capsular bag emptied into the vitreous cavity. After this procedure there were no complications. Before Nd-YAG laser posterior capsulotomy spherical equivalent was -0,42 ± 0.8 dioptri (D), after the procedure spherical equivalent was 0,52 ± 0.77 dioptri (D). The cases which were followed without intervention, did not accept the treatment modality with YAG laser procedure. The data summary and pictures of 17 patients were documented in Table 1 and Figure 2.

CONCLUSION

CBS is a rare complication of phacoemulsification with in the bag IOL implantation. Late postoperative CBS has been suggested that the fluid in the capsular bag is produced by oncotic pressure, created by the lens epithelial cells, cortical material residues and retained viscoelastic material.[2-6,13] Durak et al. represented 13 eyes that developed early postoperative CBS with viscoelastic-like material on the first postoperative day, and the author believes that the viscoelastic material could be a possible factor for early postoperative CBS occurrence.[14] Also, Holtz reported two of seven early postoperative CBS cases that resolved spontaneously. [13]

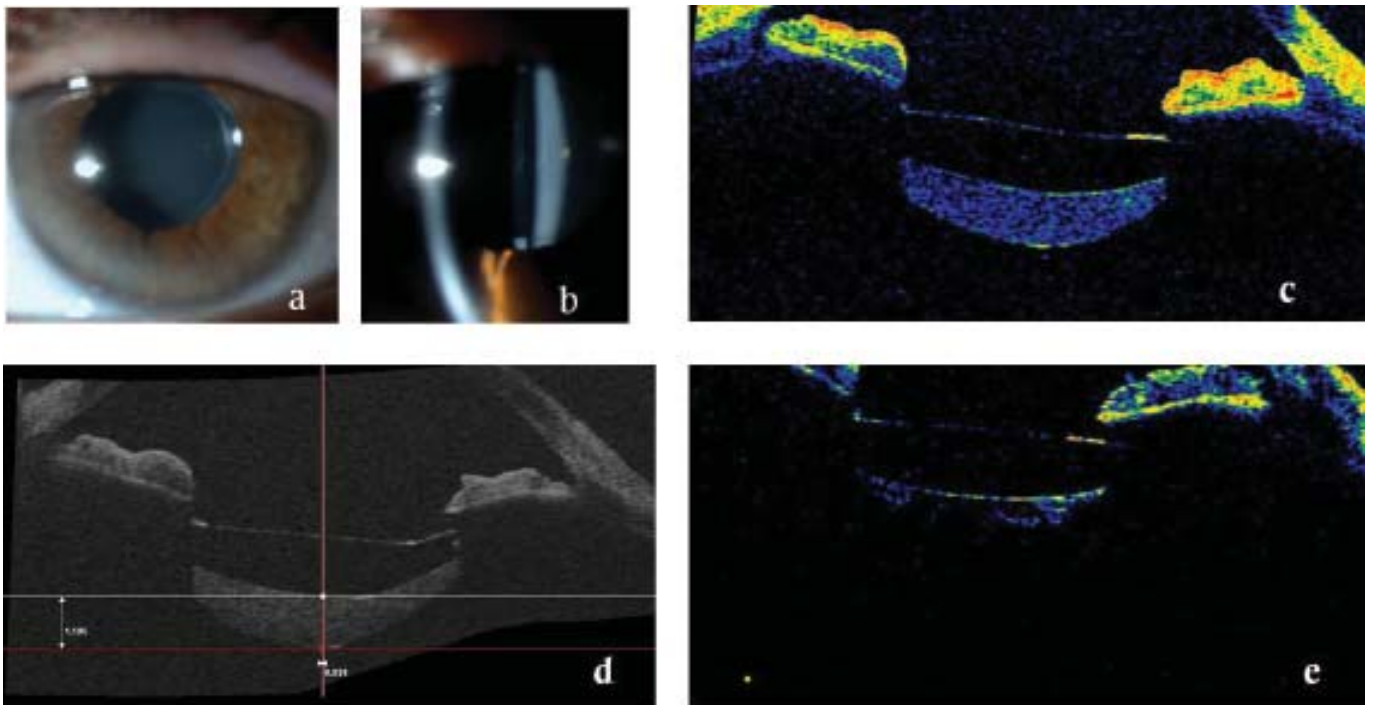
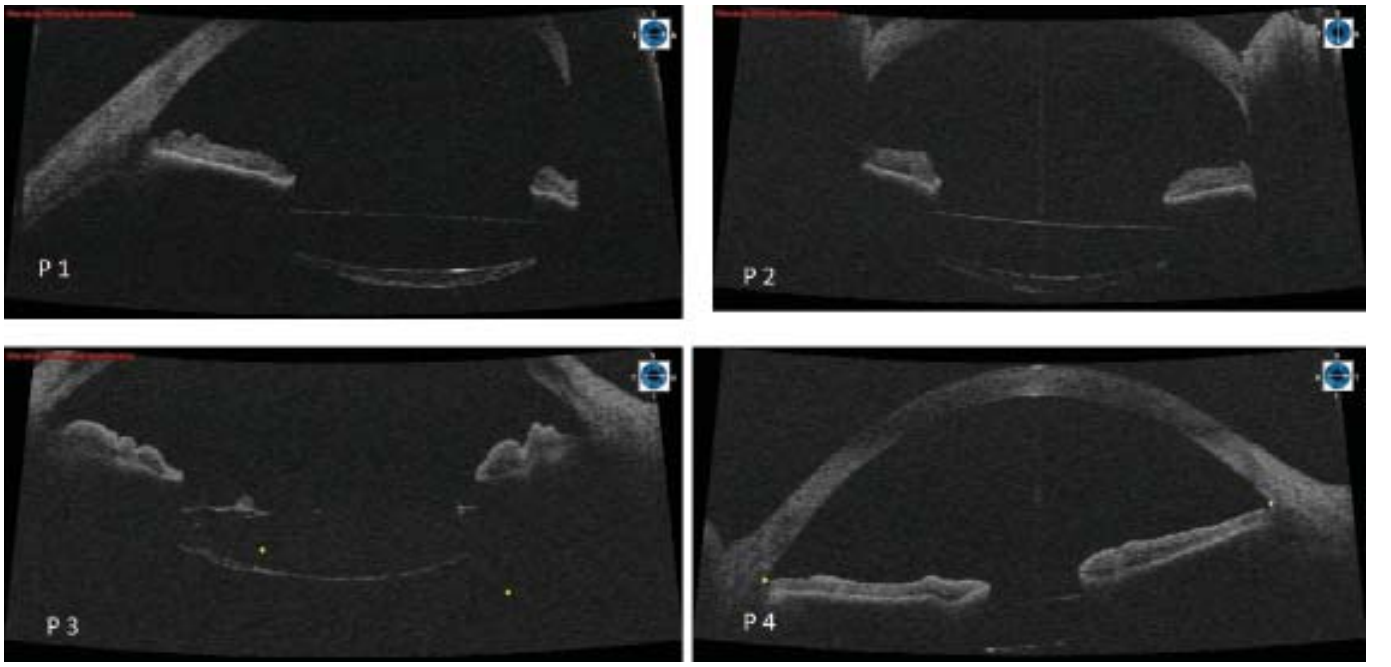


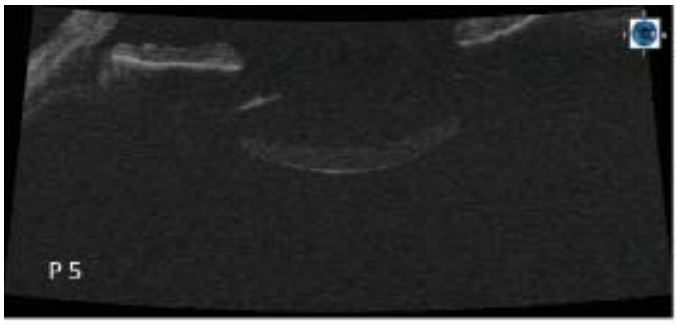
Figure 1. a) *A grey-white appearance in posterior surface of IOL with slit beam in biomicroscopic examination.* **b)** *The front view of anterior segment.* **c)** *The distended capsular bag can be seen by SL-OCT imaging in color.* **d)** *Measurement of the distended posterior capsular bag.* **e)** *The appearance of posterior capsule after Nd:YAG laser posterior capsulotomy.*

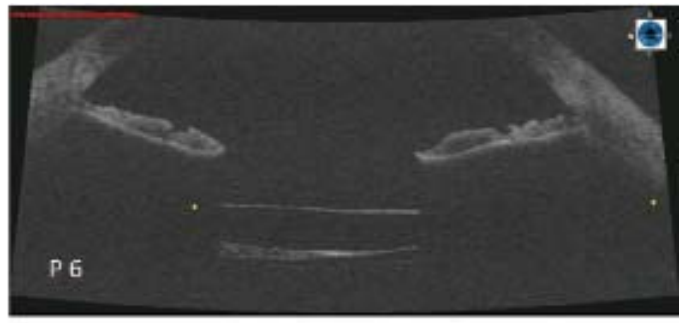
Late postoperative CBS cases may require Nd: YAG laser capsulotomy that creates the communication between the intracapsular and the extracapsular space. Resolution of the CBS returns the IOL to a normal position and reduces the myopic shift. In our patients, all cases were late onset CBS; the mean time of onset was 66.5 ± 31.6 months (range 5 to 120 months). The average reduction in the myopic shift was -0.42 Diopters(D) ± 0.8 (range -2.25 to +1.00 D). Fourteen cases underwent successful Nd:YAG laser capsulotomy resulted in evacuation of the intracapsular material.

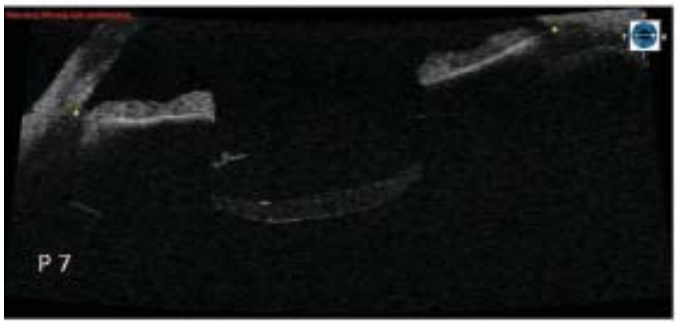
CBS is diagnosed clinically with a complete ophthalmological examination including slit-lamp and fundus examination also after pupillary dilatation. However, different anterior imaging techniques such as Ultrasound Biomicroscopy (UBM), Scheimpflug imaging and AS-OCT have been

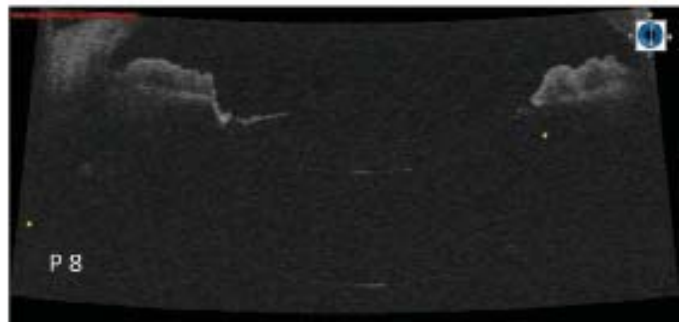
Figure 2. *Pictures of 17 patients with late onset CBS.*

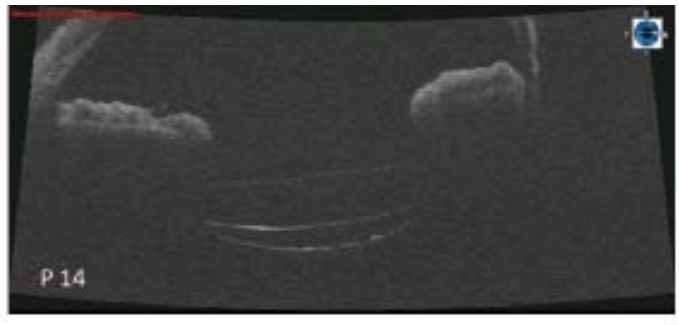


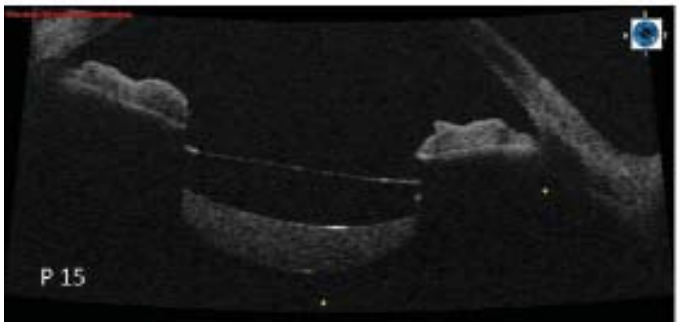


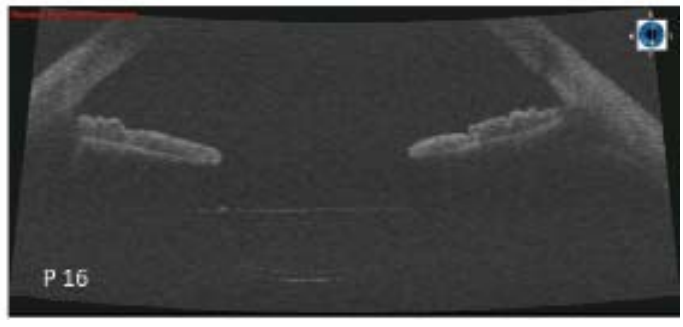


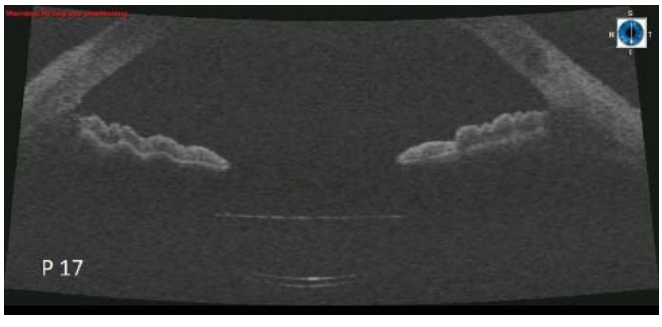












used as an aid to differentiate CBS from other pathologic situations. Kucukevcilioglu et al evaluated two late onset CBS patients with UBM and Scheimpflug imaging before and after Nd:YAG laser capsulotomy were performed. They reported that UBM seemed superior to Scheimpflug imaging in eyes with extremely distended capsular bags.[8] Scheimpflug camera requires good pupil dilatation and clear media to visualize the posterior capsule in phakic eyes.[8,15,16] In the literature there are case reports of late CBS using Scheimpflug imaging. In these reports posterior displacement of posterior capsule was less than 1.0 mm. UBM is a good diagnostic tool in anterior segment pathologies as it has a

high penetration capacity with high frequency probes. It can demonstrate structures behind the iris, which is a limitation for AS-OCT imaging. [17-18]

Neri et al showed that the images of 6 patients obtained by AS-OCT allowed observation and measurement of the morphologic characteristics of late-onset CBS. Additionally, AS-OCT measured anterior chamber depth if there was an IOL displacement before and after treatment with neodymium:YAG (Nd:YAG) laser posterior capsulotomy.[19]

Our study consists of 17 late-onset CBS cases examined by SL-OCT. SL-OCT is a slit-lamp adapted time-domain anterior segment optical coherence tomography system that employs a non-contact low coherence interferometry to obtain high resolution images.[12] This system allowed us to evaluate the anterior segment, confirm the prediagnosis CBS in few minutes following ophthalmological examination. Detailed imaging of the iris, IOL, posterior capsule and their relation was possible and biometric measurements demonstrated the extensions of the CBS. The reflectivity of the collected liquid material could also be evaluated. With a biomicroscopic examination, CBS may be misdiagnosed as an IOL opacification that requires IOL exchange which is an invasive procedure.[20] In our experience SL-OCT seems to be a useful method in diagnosing CBS, in addition to clinical presentation and slit lamp biomicroscopic examination.

As a result, high resolution images obtained by SL-OCT, which is noncontact, rapid, and noninvasive, play an important role in the diagnosis of CBS. Therefore, this imaging method may be beneficial as a complimentary tool in diagnosing and follow-up of eyes with CBS.

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