Ocular Characteristics and Phacoemulsification in Eyes with Long Anterior Zonules

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ABSTRACT

Purpose: To investigate prevalence and biometric characteristics of long anterior zonule in cases underwent phacoemulsification surgery.

Materials and Methods: We retrospectively reviewed charts of 693 consecutive patients (777 eyes) underwent phacoemulsification surgery by single surgeon (FÖ) at Ophthalmology Department of Health Sciences University, Kütahya between January 2018 and October 2019.

Results: Long anterior zonule (LAZ) was detected in 8 cases (1.15%) during surgery, 7 of which had bilateral LAZ. Of the cases with LAZ, 3 were women and 5 were men with mean age of 76.5±7.11 years. In the eyes with LAZ, mean spherical equivalent was found as +0.95±2.15 diopter whereas mean intraocular pressure as 17.73±3.33 mm Hg, mean axial length as 22.70±1.15 mm, mean keratometry as 44.02±2.46 diopter, mean anterior chamber depth as 2.90±0.21 mm, mean central corneal thickness as 553.84±44.14 µm and mean limbus-limbus distance as 11.68±0.36 mm. The mean power of intraocular lens implanted was 23.11±2.49 diopter. In addition, pigment dispersion was detected in 3 and posterior embryotoxon was detected in 1 case with LAZ. A notch in the capsulorhexis line was developed only in one patient while passing through the LAZ region during capsulorhexis stage no problem was experienced in the later stages of surgery. There was no postoperative complication in any of the cases with a mean follow-up 7.36±6.87 months.

Conclusion: In our study, eyes with LAZ tended to be hyperopic with shorted axial length in agreement with previous studies. In particular, capsulorhexis should be performed meticulously since unexpected tears may occur in the capsule.

Keywords: Long anterior zonule, Ocular characteristics, Phacoemulsification.

INTRODUCTION

Lens zonules attach to 0.25 mm anterior to lens equator and its origin extends towards anterior due to increased lens size by advancing age.[1] However, zonules attached to more anterior than normal were first reported by Koch and Liu in 1988. Authors emphasized that more meticulous manipulation should be made, particularly at capsulorhexis in cases with long anterior zonule (LAZ), since the likelihood of zonule injury may be higher during cataract surgery.[2] Despite limited number of studies in the literature, it was shown that LAZ is associated with advanced age, female gender, hypermetropia, short axial length, persistent pupillary iris membrane, pigment dispersion and late-onset retina degeneration.[3-10] In the largest series, Roberts et al. 2,647 African-American patients and detected LAZ in 59 patients (prevalence: 2.2%) in at least one eye.[4]

To best of our knowledge, there is a single study on cataract surgery in cases with in the study, it was emphasized that zonule-free capsule areas is extremely small in some cases with LAZ which may more readily lead capsule tears during capsulorhexis or intraocular lens instability.[3] In Turkey, there is no study on LAZ prevalence and cataract surgery in cases with LAZ. In this study, it was aimed to evaluate LAZ incidence among our patients and surgical outcomes and biometric characteristics in the eyes with LAZ.

MATERIAL AND METHOD

We retrospectively reviewed charts of 693 consecutive patients (777 eyes) underwent phacoemulsification surgery by single surgeon (FÖ) at Department of Ophthalmology, Kutahya Health Sciences University School of Medicine, between January 2018 and October 2019.

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The eyes included were assessed for LAZ with particular emphasis on capsulorhexis in video recordings obtained during surgery. In these cases, continuous curvilinear capsulorhexis was performed with central diameter of 5 mm. In cases with LAZ detected during surgery, contralateral eye was assessed for LAZ using high magnification and full pupil dilatation during control visit. The study was approved by Ethics Committee. The study was conducted in accordance to tenets of Helsinki Declaration. The patients with previous ocular trauma or intraocular surgery were excluded.

All patients underwent routine ophthalmological examination including BCVA measurement, intraocular pressure (IOP) measurement and anterior and posterior segment examination by slit-lamp. All patients were assessed using anterior segment analyzer with Scheimpflug camera (Oculus Pentacam, Wetzlar, Germany) before surgery and intraocular lens was selected via optic biometry (AL-Scan, Nidek Co, Ltd., Gamagori, Japan). Data were analyzed using SPSS version 20.0.

RESULTS

In our study, LAZ was detected in 8 patients (1.15%) during surgery. Table 1 presents demographic and ocular characteristics of all cases. Bilateral LAZ was detected in 7 of 8 patients. LAZ presence could not be determined in one patient due to presence of leukoma. Figure 1 represents anterior segment photographs of patients with LAZ in phakic and pseudophakic eyes.

Of the cases with LAZ, 3 were women and 5 were men with mean age of 76.5±7.11 years. In the eyes with LAZ, mean spherical equivalent was found as +0.95±2.15

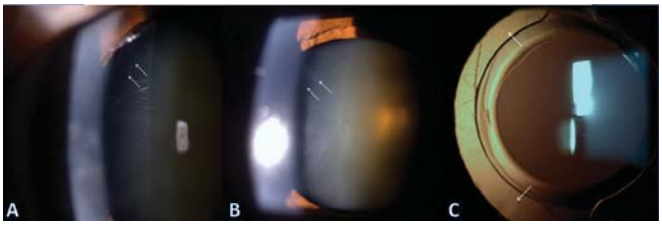

Figure 1: *Long anterior zonule image in phakic (A, B) and pseudophakic (C) eyes.*

Table 1: *General characteristics of the patients.*

	Age	Gender	IOP (mmHg)	AL (mm)	K (D)	Refraction	CCT (µm)	ACD (mm)	LLD (mm)	IOL (D)
A.Y	70	Male								
OD			16	21.78	41.26	+3.25	602		11.9	
OS			17	21.69	42.13	Err	610	2.83		28.0
E.M	77	Female								
OD			19	21.98	46.94	+3.75	253		11.6	
OS			20	22.24	45.24	+3.25	517	2.84	11.9	24.0
M.K	83	Female								
OD			11	21.90	44.12	+1.5	509	2.68	12.2	26.0
OS			13	22.12	44.58	+1.5	507	2.80	11.9	25.0
M.A	63	Male								
OD			22	24.48	40.86	-2.5	600	3.29	11.8	21.5
OS			23	24.39	40.66	-1.0	601	3.26	11.9	
N.I	82	Female								
OD			20	22.28	45.24	+3.0	538	2.72	11.3	
OS			19	20.42	50.07	+3.0				25.5
Ö.K	74	Male								
OD			19	23.68	44.25	-1.75	569	2.73	11.3	20
OS			20	23.58	43.25	+1.25	565	2.98	11.2	20.5
K.Y	81	Male								
OS			17	23.97	42.50	-0.75	468	3.07	12.2	20.5
H.G	82	Male								
OD			16	23.17	44.25	-1.5	557	2.94	11.3	21.5
OS			14	22.91	45.00	+0.25	567	2.67	11.3	

OD: Right eye; OS: Left eye; IOP: Intraocular pressure; AL: Axial length; K: Keratometry; CCT: Central corneal thickness; ACD: Anterior chamber depth; LLD: Limbus-to-limbus distance; IOL: Intraocular lens

diopter whereas mean intraocular pressure as 17.73±3.33 mm Hg, mean axial length as 22.70±1.15 mm, mean keratometry as 44.02±2.46 diopter, mean anterior chamber depth as 2.90±0.21 mm, mean central corneal thickness as 553.84±44.14 µm and mean limbus-limbus distance as 11.68±0.36 mm. The mean power of intraocular lens implanted was 23.11±2.49 diopter. There was segmental LAZ in 5 and complete LAZ in 3 of 8 cases. In addition, pigment dispersion was detected in 3 and posterior embryotoxon was detected in 1 case with LAZ. Mean follow-up duration was 7.36 ±6.87 months after surgery. A notch in the capsulorhexis line was developed only in one patient while passing through the LAZ region during capsulorhexis stage no problem was experienced in the later stages of surgery. Figure 2 shows notching during surgery. No postoperative complication was observed in any case. Figure 3 and 4 shows anterior segment photographs captured during cataract surgery in cases with LAZ.

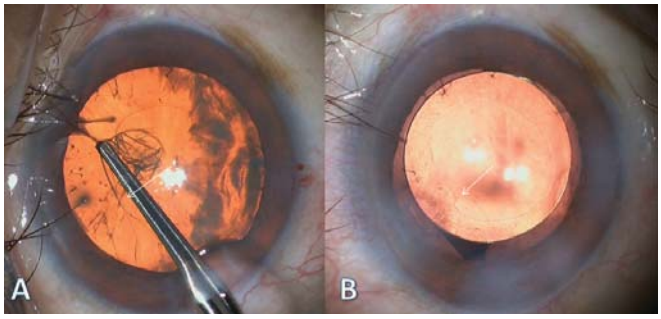

Figure 2: *A capsular notch developed at long anterior zonule region during capsulorhexis (A,B).*

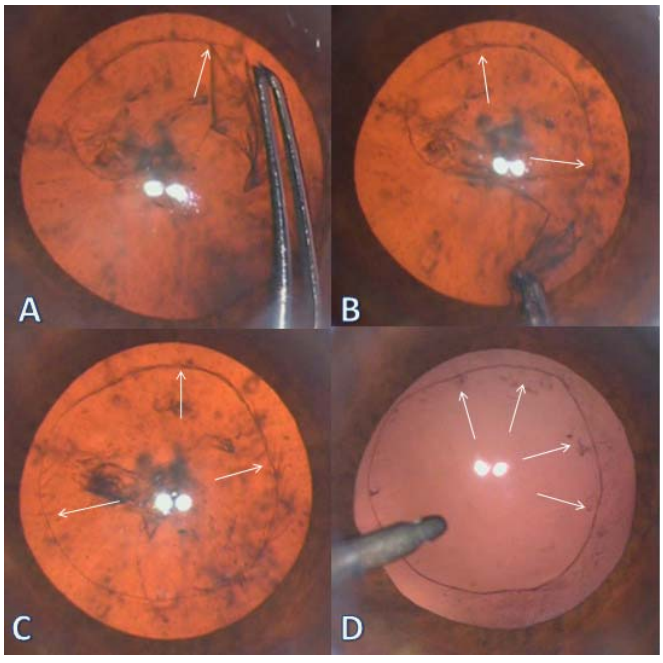

Figure 3: *Long anterior zonule image during capsulorhexis (A, B, C) and after cortex (D).*

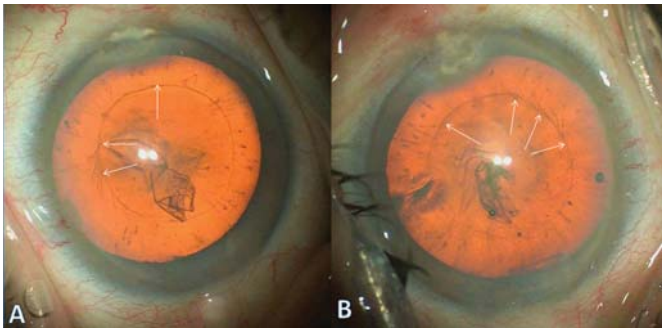

Figure 4: *Long anterior zonule image in right (A) and left eyes (B) after capsulorhexis in the same patient.*

DISCUSSION

Zonule-related problems are one of the major factors affecting success of cataract surgery. Preoperative detection of cases with LAZ may lead surgeons to be more careful during surgery and prevent complications. The complications include capsule tear and resultant lens displacement into vitreous, vitreal displacement towards anterior chamber or failure to implant lens into capsule. In the literature, there is only one study on cataract surgery in patients with LAZ. In the study, Roberts et al.[3] retrospectively reviewed cataract surgeries in 227 eyes with LAZ and reported no perioperative or postoperative complication. In our study, a notch secondary to LAZ during capsulorhexis in one patient; however, no complication was observed at postoperative period. During capsulorhexis, unexpected capsule tear may occur due to vectorial contraction towards lens equator in areas with LAZ.

In another study Roberts et al.[6] it was reported that there was advanced age, hypermetropia and shorter axial length 61 African-American patients with LAZ. Our results are in agreement with above-mentioned study. In our study, mean spherical equivalent was found to be lower when compared to mean axial length as a result of myopic effect of nuclear cataract.

In cases with LAZ, hypermetropia and shorter axial length are also risk factors for angle closure glaucoma. Although literature suggests that LAZ is associated with both open angle and narrow-angle glaucoma subtypes, actual risk for glaucoma hasn't been fully understand or proven as similar to our study. In a study on 2,740 patients including 129 cases with LAZ not using any anti-glaucomatous agent, Roberts et al.[4,11] showed that IOP was higher by 1.3 mmHg in average in eyes with LAZ when compared to those without. Roberts et al. concluded that risk for glaucoma may be higher in cases with LAZ. In our study, mean IOP was found as 17.7 mmHg and no glaucoma case was detected.

The increased pigment dispersion is another factor that may increase risk for glaucoma in cases with LAZ. It was proposed that mechanical friction will be greater between long zonules and iris epithelium.[10,11] Moroi et al.[10] reported association of LAZ with pigment dispersion in 15 cases, 7 of which were treated for glaucoma. In our study, pigmented LAZ was detected in 3 cases.

A residue of tunica vasculosa lentis generally evolves to pupillary membrane that disappears during early life. In a study on 74 cases with LAZ and 74 controls, Roberts et al.[12] detected persistent pupillary membrane in 29 of 74 eyes with LAZ and 15 of 74 controls. Authors interpreted the significant difference as there may be an association between persistent papillary membrane and LAZ. Although there was no case with persistent papillary membrane in our study, we detected posterior embryotoxon which hasn't been reported in association with LAZ so far.

Late-onset retinal degeneration is another condition reported in association with LAZ.[7-9] Ayyagari et al.[11] found association of LAZ with late-onset retinal degeneration in S163R mutation carriers in CTRP5 gene located at long arm of chromosome. The CTRP5 is short-chain collagen gene and the mutation accounting for LAZ and retina degeneration is characterized with serine-arginine replacement. It is an autosomal dominant condition characterized by progressive degeneration and rare involvement of retina. Choroidal neovascular membrane and Drusen accumulation are seen in individuals affected, which involve macula and cause severe loss of vision at fourth to sixth decades of life. This is particularly important since LAZ detected at younger age may be an early marker for maculopathy. Thus, in addition to anterior segment, posterior segment should also be monitored as cases with LAZ are at risk for macular degeneration. When four generations of pedigree were assessed in 55 individuals, LAZ was detected in 18 family members aged 24-80 years and there was significant, visible macular degeneration in 10 of the patients. Macular degeneration was detected in all 6 individuals with LAZ aged >48 years while no clinical macular degeneration was detected in those aged<48 years.[8] No macular degeneration was detected in any cases in our study.

This study has some limitations including limited sample size. In addition, the diagnosis of LAZ was made at time of capsulorhexis during surgery. It is known that there are LAZs not extending to standard capsulorhexis line. However, we think that such cases have no effect surgical stages. In addition, this is the first study reporting preliminary results for Turkish population. Given that LAZ incidence is 1-2%, larger studies will demonstrate LAZ frequency and characteristics of patients with LAZ. For this purpose, we are maintaining a registry on patients with LAZ. Another limitation is lack of genetic analysis in our cases.

CONCLUSION

In agreement with previous studies, we found that eyes with LAZ are hypermetropic with shorter axial length. In cases with LAZ, one should be careful regarding diameter of zonule-free central region during capsulorhexis and completion of capsulorhexis within the area, when possible, will ensure less complication. If a large capsulorhexis isn't performed in LAZ cases not extending to central area (5 mm in diameter), LAZ has no contribution to complication development. However, if there is insufficiency regarding zonule-free area, a more meticulous manipulation should be performed, particularly, during capsulorhexis, since capsule tends to tear in a radial manner towards periphery while passing areas of LAZ.

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