

# Effect of Combined Phaco-Trabeculectomy on the Anterior Segment Parameters

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## ABSTRACT

**Purpose:** To evaluate the effect of phaco-trabeculectomy in the presence of primary open-angle glaucoma (POAG) and cataract on the anterior segment parameters.

**Material and Methods:** We included the POAG cases with cataract who had underwent combined phaco-trabeculectomy to this retrospective study. The age, sex, preoperative and postoperative 6th month visual acuity (VA) according to LogMAR, intraocular pressure (IOP) measured by Goldmann applanation tonometer, keratometry values (K), central corneal thickness (CCT), corneal volume (CV), anterior chamber depth (ACD), and anterior chamber angle (ACA) measured with corneal topography were recorded.

**Results:** Sixteen (29.62%) of the patients were female, 38 (70.37%) were male. The average age was 61.6±15.1 (28-83). The VA was 0.7±0.2 in the preoperative period and 0.47±0.1 in the postoperative 6th month according to the logMAR ( $p<0.05$ ). The mean IOP was measured as 35.5±12 mmHg under maximum medical treatment in the preoperative period, and was measured as 11.7±2.9 mmHg without any treatment in the postoperative 6th month ( $p=0.00$ ). During follow-up, none of the patients had increased IOP at the level that required medical treatment. There were no significant differences in K values, CV and CCT between the preoperative and postoperative 6th months' values ( $p>0.05$ ). ACD and ACA showed a significant increase in the postoperative period ( $p=0.00$ ,  $p<0.029$ ).

**Conclusion:** Combined phaco-trabeculectomy led to an increase in the mean visual acuity as well as effective IOP reduction. In addition, changes in anterior segment parameters were shown in the postoperative period in patients undergoing phaco-trabeculectomy, and it was thought that this may have effects on refraction and IOP.

**Keywords:** Combined phaco-trabeculectomy; keratometry; anterior segment parameters.

## INTRODUCTION

Primary open angle glaucoma (POAG) and cataract are ocular morbidities seen the most common in advanced ages.<sup>1</sup> In the treatment of POAG, which leads to progressive vision loss, when medical therapy fails, trabeculectomy is an important surgical technique that reduces intraocular pressure (IOP) and prevents the damage of optic nerve due to glaucoma.<sup>2</sup> In the presence of glaucoma and cataract, besides combined phacoemulsification and trabeculectomy, singly trabeculectomy or phacoemulsification can be performed. In the group of patients who underwent previous trabeculectomy, cataract making progress, and deterioration of the bleb function with subsequently performed phacoemulsification, and consequently, an increase in IOP was shown.<sup>3,4</sup> When these risks are taken

into consideration, in a single session with combined surgery to achieve a decrease in IOP and an increase in visual acuity, provides an important advantage, especially in the elderly patient group.<sup>5-7</sup>

Nowadays, trabeculectomy and phacoemulsification surgeries are known to cause changes in the refraction, anterior chamber parameters, and topography.<sup>8-14</sup> Considering the fact that the axial length, anterior chamber parameters, and stabilization of the keratometry (K) values may take 1 year, especially in cases where previous trabeculectomy is performed in the presence of cataract and glaucoma; it is inevitable to obtain unwanted refractive results with phacoemulsification performed immediately after trabeculectomy.<sup>12,13</sup> In addition, it was shown that phacoemulsification performed after trabeculectomy may

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compromise bleb function and the short duration between these two surgeries will increase the risk of failure.<sup>4</sup> However, it was stated that in combined surgery, anterior chamber depth (ACD), K, and axial length may fluctuate and cause unexpected refractive results.<sup>8-15</sup>

In this study, it was aimed to evaluate the effect of combined phaco-trabeculectomy on the anterior segment parameters in patients with the association of POAG resistant to medical treatment, and cataract.

## MATERIALS AND METHODS

The current study was conformed to the contents of the Declaration of Helsinki, meanwhile was authorized by the Institutional Review Board/Ethics Committee of Gazi Yasargil Training and Research Hospital. All subjects had written the informed consent before enrollment.

The files of patients who underwent combined phacoemulsification and trabeculectomy with the diagnosis of POAG resistant to medical treatment (IOP > 21 mmHg maximum medical treatment) with grade 3-4 cataract were evaluated retrospectively in between 2015-2018. POAG was defined as IOP > 21 mmHg, grade 3-4 open anterior chamber angle according to Shaffer grading system, and presence of glaucomatous visual field defects and retinal nerve fiber layer (RNFL) defects.

Patients who did not attend follow-up, had previous intraocular surgery or had additional ocular pathology (active infection, corneal pathologies, uveitis, retinal disorders etc.), diabetes mellitus, previous systemic or topical steroid use, previous ocular trauma, axial length < 21 mm or > 26 mm and serious complications due to surgery such as posterior capsule rupture, persistent corneal oedema, endophthalmitis, persistent hypotonia, leakage from surgery sites, choroidal detachment, failure of trabeculectomy and raised IOP and presence of sulcus placed intraocular lens (IOL) or scleral fixation IOL were not included in the study.

The patients' age, sex, c/d ratio, anterior chamber angle evaluated by gonioscopy using a Goldmann three-mirror lens, pre- and postoperative 6-month best-corrected visual acuities according to LogMAR, IOP measured by Goldmann applanation tonometry, autorefractometric and topographic measurements, and intraoperative and postoperative complications were recorded from the patients' files. Autorefractometer measurements of the patients were performed with Topcon KR-8000 (Topcon Medical Systems, Oakland, NJ), corneal topography with Oculus Pentacam HR (Oculus, Wetzlar, Germany), the biometry and axial length measurements with the OTI Scan 3000 ultrasound system (OPKO Instrumentation,

LLC, USA) at pre- and postoperative 6-month. Intraocular lens power was calculated with the SRK/T formula.

K<sub>1,2</sub> measurements were obtained with autorefractometer, K<sub>1</sub> and K<sub>2</sub>, central corneal thickness (CCT), ACD, corneal volume (CV), and anterior chamber angle (ACA) measurements were obtained with topography.

## Surgical Technique

All operations were performed under local anesthesia, by only one experienced surgeon. Following subconjunctival lidocaine hydrochloride injection, the conjunctiva was opened fornix-based, in 12 o'clock alignment. The sclera was cauterized. 50 mg/ml 5 fluorouracil (5 FU) impregnated sponge was applied in between the conjunctiva and the sclera for 2 minutes. Subsequently, the region was washed with plenty of saline solution. Scleral flap, which its base facing the limbus and 3 × 3 mm in size, was removed. Then phacoemulsification was started with Centurion® Vision System (Alcon Centurion System, USA). The port with limbal input opened at 6 and 12 o'clock. Viscoelastic was given to the anterior chamber and 2.75 mm scleral tunnel was opened in the right eye from the temporal and in the left eye from the nasal. 5.5 mm capsulorhexis was performed. Hydrodissection and subsequently the cleansing of the lens with the phaco-chop method, and the cleansing of the cortex material with irrigation and aspiration were performed. A AcrySof SA60AT (Alcon, Fort Worth, TX, USA) implantation to the capsular sac was performed. The trabecular mesh was drawn in a rectangular shape, the trabecular mesh was removed, peripheral iridectomy was performed. Scleral flap was sutured with 3 separated units of 10/0 nylon suture, tenon and conjunctiva were sutured with 8/0 vicryl suture. In the ports, edema was induced. Moxifloxacin was administered to the anterior chamber and the operation was ended.

## Statistical Analyses

Mean, standard deviation, median lowest, highest, frequency and ratio values were used in descriptive statistics of the data. The distribution of the variables was measured by the Kolmogorov Smirnov test. The matched sample t-test and Wilcoxon test were used to analyze the dependent quantitative data. Correlation between IOP reduction and anterior chamber parameters found was performed with Pearson's correlation.

## RESULTS

Fifty-four eyes of 54 patients who underwent combined phaco-trabeculectomy and attended followed-up were included in the study. 16 of the patients were female

(29.62%) and 38 (70.37%) were male. The average age of the patients is  $61.6 \pm 15.1$  (28-83) (Table 1). The mean c/d ratio was 0.6 (0.4-0.9).

Age (a)	$61.6 \pm 15.1$ (28-83)
Gender (F:M)	16/38
a: average; F: female; M: Male	

The average visual acuity according to the logMAR was determined as  $0.7 \pm 0.2$  in the preoperative period and  $0.47 \pm 0.1$  in the postoperative 6th month ( $p < 0.05$ ). In 20 (37%) patients, who had advanced glaucoma, increase in visual acuity was not obtained. The mean IOP was  $35.5 \pm 12$  mmHg (21-70 mmHg) under maximum medical treatment in the preoperative period and  $11.7 \pm 2.9$  mmHg (8-18 mmHg) without any treatment in the postoperative 6th month ( $p=0.00$ ).

K values, CV, ACD, CCT and ACA measurements obtained in the preoperative and in the postoperative 6th month are given in Table 2. According to these results, no significant difference was found between  $K_1$  and  $K_2$  values at preoperative and postoperative 6th month ( $p=0.420$ ,  $p=0.825$ ). In addition, the keratometric measurements obtained with both Topcon KR-8000 and Pentacam were found to be similar. Besides, there was no statistically significant change in CV and CCT obtained by topography ( $p=0.306$ ,  $p=0.155$ ).

ACD was measured as  $2.7 \pm 0.7$  mm preoperatively and  $3.3 \pm 0.7$  mm at postoperative 6th month and postoperative increase obtained was found to be statistically significant ( $p=0.00$ ).

ACA was preoperatively measured as  $33.7 \pm 10.4^\circ$ , and at the postoperative 6th month as  $41.2 \pm 6.8^\circ$  and there was a statistically significant increase in the angle at the postoperative period was determined ( $p=0.029$ ).

	Min-Max	Average	p
IOP (mmHg)			
preoperative	21.0-70.0	$35.5 \pm 12.0$	0.000 <sup>w</sup>
postoperative	8.0-18.0	$11.7 \pm 2.9$	
K1 (D)			
preoperative	39.0-47.3	$43.4 \pm 2.1$	0.420 <sup>w</sup>
postoperative	38.3-46.3	$43.4 \pm 2.3$	
K2 (D)			
preoperative	40.8-48.3	$44.6 \pm 2.1$	0.825 <sup>w</sup>
postoperative	39.8-48.0	$45.0 \pm 1.8$	
K1-topographic (D)			
preoperative	38.5-46.2	$43.1 \pm 1.8$	0.952 <sup>w</sup>
postoperative	39.4-45.2	$43.3 \pm 1.6$	
K2-topographic(D)			
preoperative	39.9-48.5	$44.5 \pm 2.0$	0.407 <sup>w</sup>
postoperative	41.6-47.9	$44.7 \pm 1.6$	
ACD (mm)			
preoperative	1.6-4.6	$2.7 \pm 0.7$	0.000 <sup>E</sup>
postoperative	2.2-4.3	$3.3 \pm 0.7$	
ACA(°)			
preoperative	19.7-60.0	$33.7 \pm 10.4$	0.029 <sup>E</sup>
postoperative	30.8-55.9	$41.2 \pm 6.8$	
CCT (µm)			
preoperative	454-583	$519.7 \pm 39.1$	0.155 <sup>E</sup>
postoperative	468-601	$530.5 \pm 45.3$	

**IOP:** intraocular pressure, **K:** keratometry, **ACD:** anterior chamber depth, **ACA:** anterior chamber angle, **CCT:** central corneal thickness, **w:** Wilcoxon test, **E:** Matched sample test. **Min-Max:** Minimum-maximum.

There were no correlation between preoperative and postoperative ACD, ACA measurements and the postoperative IOP reduction ( $p > 0.05$ ).

None of the patients included the study had serious complications in the intraoperative period. Postoperatively, one patient developed large subconjunctival hemorrhage in the trabeculectomy area on the 1st day. An increase in IOP was detected due to the deterioration of aqueous drainage because of the hemorrhage. The patient was re-operated on the same day and the hemorrhage was cleaned and the decrease in IOP was provided at follow-up. In three patients (11.1%), fibrinous uveitis developed in the anterior chamber on the postoperative first day. With the use of topical prednisolone acetate per hour, the reaction was regressed. No additional complication was observed during follow-up.

## DISCUSSION

Today, already, there is no common consensus on the surgical treatment of cataract and medical treatment-resistant glaucoma. Studies have shown that in patients with glaucoma, phacoemulsification performed alone is provided an increase in vision and a decrease of 2-4 mmHg in IOP. However, it was revealed that besides the obtained increase in the visual acuity with the combined surgery in the long term, better IOP control was achieved in comparison with the long-term phacoemulsification alone, and the need for additional medical treatment was found to be less. In addition, it was stated that IOP increases in perioperative and early postoperative period may increase the present glaucomatous damage in the patients with advanced postoperative glaucoma who underwent primarily phacoemulsification and consequently, the increase in visual fracture may not be obtained. All these results suggest that combined surgery is superior to the phacoemulsification alone, especially in patients with advanced glaucoma and cataract.<sup>6,7,16,17</sup>

In our study, a significant increase was obtained in average visual acuity after the combined surgery, similar to other studies.<sup>18,19</sup> In addition, a significant decrease in IOP in all patients was determined with combined surgery, and this decrease could be kept under control for 6 months without the need for additional medical treatment. However, although an effective IOP reduction was provided with an uncomplicated surgery in some patients, vision increase could not be achieved due to advanced glaucomatous damage. This result proves that combined surgery performed in early stages in patients with medical treatment-resistant glaucoma can be an important approach that can effectively reduce IOP and prevent optic nerve injury and increase visual acuity.

It is known that keratometric measurements change after trabeculectomy and phacoemulsification surgeries and accordingly, astigmatism may develop. In addition, even if IOP reduction is provided in glaucoma patients to prevent glaucomatous damage and visual loss due to it, surgically induced astigmatism can reduce the visual acuity we are trying to protect.<sup>21-23</sup> The wound site contraction caused by cauterization of the sclera during the trabeculectomy and the tight suturing of the flap may cause steepening in the vertical meridian and astigmatism in accordance with the rule.<sup>12,21,22</sup> In phacoemulsification surgery, localization, size, and configuration of the incision affect the postoperative corneal curvature and astigmatism.<sup>24</sup> Corneal curvature is less affected, especially in surgeries where the incision is made on the horizontal meridian compared to ones performed on the vertical meridian.<sup>24,25</sup> Hashemian et al<sup>17</sup> have determined that in patients underwent combined phaco-trabeculectomy, low-grade astigmatism with an insignificant reduction in the average K have developed and showed that this change remained stable for 6 months postoperatively. In the study of Law et al<sup>26</sup> an increase in the postoperative average K values of the group in which the combined surgery was performed, was determined. In this study, the wound site was closed by corneal suturing and it was argued that the increase in K values and astigmatism developed for this reason. In our study, it was determined that keratometric measurements did not show a significant change in the postoperative period compared to the preoperative period. In addition, it was found that there was no difference between the keratometric measurements obtained with two separate devices and this was thought to increase the reliability of the measurements. During the phacoemulsification, we performed a scleral tunnel in the horizontal axis instead of corneal and minimal corneal intervention was performed. Therefore, it was thought that the combined surgery did not induce keratometric changes. However, since keratometric measurements in the early postoperative period were not performed in our study, it was not possible to evaluate how keratometric measurements changed immediately after the operation.

Intraocular surgeries affect the ACD, ACA and IOP due to it. Following uncomplicated cataract surgery, ACD and ACA are increasing and IOP is decreasing.<sup>27</sup> Elgin et al. demonstrated decrease in IOP and increase in the ACD measurements in patients with POAG and pseudoexfoliation glaucoma after uncomplicated cataract surgery. In this study, in pseudoexfoliation glaucoma increase in ACD measurements was found larger than POAG because of ciliary zonular laxity.<sup>28</sup> After trabeculectomy, it was shown that in the early postoperative period, ACD and ACA were decreased, CCT was increased and in the late period, ACD, ACA, and CCT were returned to preoperative values.<sup>29,30</sup>

Increased ACD in the early period after trabeculectomy can be used as an indicator for non-functioning of bleb and IOP increase.<sup>29</sup> In the literature, there are no studies evaluating ACD and ACA after combined surgery. In our study, we determined a significant increase in ACD and ACA compared to the preoperative period with the decrease in IOP at 6 months postoperatively. This increase indicates that phacoemulsification is more effective in anterior chamber parameters than in trabeculectomy in combined surgery. The fact that these parameters were not evaluated in the early postoperative period is the missing aspect of our study and cannot reveal how the anterior chamber depth and angle change over time in combined surgery.

The effective IOP reduction with combined phaco-trabeculectomy as well as the increase in average visual acuity proved that this surgery could be performed effectively and reliably. In our study, it was found that keratometric measurements were not affected by combined surgery, but an increase in the ACD and ACA was determined. The long-term follow-up on the effect of this increase in anterior chamber parameters should be evaluated with wide-ranging studies.

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