ARTICLE

Long-term comparison of postoperative refractive outcomes between phacotrabeculectomy and phacoemulsification

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Purpose: To compare long-term postoperative refractive outcomes between phacotrabeculectomy and phacoemulsification, both with posterior chamber intraocular lens implantation.

Setting: Department of Ophthalmology, Konyang University, Kim's Eye Hospital, Myung-Gok Eye Research Institute, Seoul, South Korea.

Design: Retrospective comparative study.

Methods: Postoperative refractive outcomes were compared between patients with cataract and coexisting primary or secondary open-angle glaucoma (OAG) who had phacotrabeculectomy (combined group) and patients with cataract with or without coexisting OAG who had phacoemulsification alone (phaco-only group). The refractive prediction error, mean absolute error, and median absolute error were compared between groups. Subgroup analysis based on preoperative axial length (AL) was performed (medium >22.0 to <24.5 mm; medium-long ≥24.5 to <26.0 mm; long ≥26.0 mm).

Results: The combined group comprised 51 eyes and the phaco-only group, 74 eyes. The mean interval between surgery and refraction measurement was 14.70 months ± 10.80 (SD) (median 13.0 months) and 4.81 ± 4.97 months (median 2.0 months), respectively. Postoperatively, there was no statistically significant between-group difference in the following mean values: refractive prediction error, −0.05 ± 0.64 versus −0.04 ± 0.52 (P = .905); mean absolute error, 0.46 ± 0.44 versus 0.38 ± 0.36 (P = .258); median absolute error, 0.32 (interquartile range [IQR], 0.17, 0.67) versus 0.28 (IQR, 0.13, 0.54) (P = .297). Subgroup analysis also did not show significant differences between the 2 groups (all P > .05).

Conclusion: The long-term postoperative refractive outcomes of phacotrabeculectomy and phacoemulsification alone were not significantly different in eyes with OAG, regardless of preoperative AL.

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The estimation of the accuracy of preoperative biometry (axial length [AL], anterior chamber depth [ACD], and keratometry [K] value) in cataract surgery has become more crucial for achieving satisfactory refractive outcomes because formulas for intraocular lens (IOL) power calculation are based on these biometric variables.[1] Previous studies report reductions in AL and ACD after trabeculectomy[2,3] and these reductions were more pronounced after phacotrabeculectomy.[4,5] Therefore, it has been expected that the refractive errors after phacotrabeculectomy would be greater if the same IOL power calculation formula for phacoemulsification were used.

Results in recent studies[1,4,6] suggest that the myopic refractive prediction error is more common and greater after phacotrabeculectomy than after phacoemulsification alone. In contrast, Law et al.[7] found no significant difference between the expected refractive error and observed refractive error. However, previous studies[1,6–8] reported relatively short-term refractive outcomes, with a mean interval between surgery and refraction measurement of 6 months or less. Furthermore, those studies included patients with various types of glaucoma.

Because postoperative biometric changes could be different between patients with open-angle glaucoma (OAG) and those with angle-closure glaucoma (ACG),[9] the inclusion of both types of glaucoma in the study might affect the results. Therefore, we studied the long-term refractive outcomes by comparing the prediction errors between patients with cataract and coexisting primary or secondary OAG who had phacotrabeculectomy (combined group)

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and patients with cataract with or without coexisting OAG who had phacoemulsification alone (phaco-only group).

PATIENTS AND METHODS

This retrospective comparative study was approved by the Institutional Review Board (IRB), Kim's Eye Hospital, Seoul, South Korea. Given that this study was based on retrospective data review, the IRB exempted the need for informed consent from the participants. All procedures conformed to the tenets of the Declaration of Helsinki.

The medical records of patients who had uneventful phacotrabeculectomy (combined group) or uneventful phacoemulsification alone (phaco-only group) performed by the same glaucoma specialist (B.H.A) between December 2013 and December 2016 were retrospectively reviewed. Patients who had previously undergone intraocular or corneal surgery and had a postoperative corrected distance visual acuity (CDVA) of 20/200 or worse were excluded because refractive outcomes could not be measured adequately in these patients. In addition, patients who had gonioscopic findings showing a closed angle and an AL less than 22.0 mm were excluded from both groups. In cases with bilateral presentation, 1 randomly selected eye was analyzed.

Data Collection

All data obtained the review of patient medical records included age; sex; date of surgery; type of glaucoma; preoperative and postoperative intraocular pressure (IOP) measured using Goldmann applanation tonometry; CDVA; preoperative subjective refractive error; preoperative AL, ACD, and K values measured using partial coherence interferometry (PCI)-based IOLMaster (Carl Zeiss Meditec AG); predicted refraction; and postoperative subjective refraction. The subjective refraction measurement was performed by 2 experienced optometrists, and the refraction value was converted to the spherical equivalent (SE). For comparison, the visual acuity was converted to the logarithm of the minimum angle of resolution equivalent. The predicted refraction values were calculated using the SRK/T formula without an optimized A-constant.[10]

Surgical Technique

The phacotrabeculectomy surgery was performed through separate incisions. Conjunctival and scleral flaps were created, and cataract surgery was performed before a block of trabecular section was removed. In brief, the trabeculectomy was performed with a superotemporal fornix-based conjunctival flap and partial-thickness rectangular scleral flap (4.0 mm × 3.0 mm). In all cases, 0.4 mg/mL of mitomycin-C was applied for 3 minutes. The scleral flap and conjunctiva were sutured with interrupted 10-0 nylon sutures. In both groups, cataract surgery was performed using a 2.8mm, superotemporal for the right eye and superonasal for the left eye clear corneal approach and a standard phacoemulsification technique. The wound was sealed with stromal hydration rather than suturing. All patients had implantation of an Acrysof IQ SN60WF IOL (Alcon Laboratories, Inc.).

Outcome Measures

The main outcome measure was the refractive prediction error, which is defined as the actual postoperative subjective SE refraction minus the predicted SE refraction. In addition, the mean absolute error which is defined as the average of the absolute value of refractive prediction errors, and median absolute error as the central location of the absolute errors were calculated in each group. The percentages of eyes that had a prediction error of ±0.25 diopter (D), ±0.50 D, ±1.00 D, and more than ±2.00 D were calculated. Subgroup analysis was performed in the following AL groups: medium (>22.0 to <24.5 mm), medium-long (≥24.5 to <6.0 mm), and long (≥26.0 mm).

Statistical Analysis

All statistical analyses were performed using SPSS software (version 9.0, SPSS, Inc.). Continuous variables were summarized using the mean and standard deviation, while categorical variables were represented as percentages. The independent *t* test (continuous variables) and chi-square test (categorical variables) were used to compare demographic information, preoperative characteristics, and refractive outcomes between the 2 groups. The Mann-Whitney *U* test was used to compare median values (median absolute error) and for data that were not normally distributed.

RESULTS

The combined group comprised 51 eyes and the phaco-only group, 74 eyes. Table 1 shows the demographic data and preoperative basic characteristics. There were no significant differences in mean age, sex, laterality, or the preoperative CDVA, AL, ACD, and K values between the 2 groups. However, the distribution of baseline ocular disease and preoperative IOP was significantly different, as expected ($P < .001$).

Table 2 shows the postoperative characteristics and refractive outcomes. After surgery, the improvement in CDVA was smaller in the combined group than in the phaco-only group ($P = .033$). The IOP reduction (both mm Hg and %) was statistically significantly greater in the combined group than in the phaco-only group ($P < .001$). The mean time between surgery and refraction measurement was also statistically significantly greater in the combined group ($P < .001$).

Regarding refractive outcomes, the refractive prediction error, mean absolute error, and median absolute error were slightly greater in the combined group than in the phaco-only group; however, there were no statistically significant differences in these parameters (Table 2). The percentages of eyes that had a prediction error within ±0.25 D, ±0.50 D, ±1.00 D, and more than ±2.00 D were not significantly different between the 2 groups (all $P > .05$).

Table 3 shows the distribution of patients in the 3 subgroups based on the preoperative AL. There were no statistically significant differences in the refractive outcomes (refractive prediction error, mean absolute error, and median absolute error) between the 2 groups (all $P > .05$). However, in the medium AL subgroup the median absolute error was significantly greater in the combined group than in the phaco-only group ($P = .034$) (Table 4).

There was no statistically significant between-group difference in the proportion of patients with a myopic refractive prediction error (myopic shift) or hyperopic refractive prediction error (hyperopic shift) that was more than 0.50 D or 1.00 D (Table 5).

DISCUSSION

Precise measurement of preoperative biometry is essential to achieve accurate refractive correction after cataract surgery.[1] However, it is difficult to predict the postoperative refractive outcomes because the ACD and AL decrease after glaucoma filtration surgery and these changes could persist for up to 1 year.[11–13] However, to date, there is a paucity of