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COMPARISON OF THE TARGET REFRACTIVE VALUE AND THE RESULTING REFRACTIVE VALUE IN PATIENTS UNDERGOING PHACOEMULSIFICATION SURGERY

FAKOEMÜLSİFİKASYON CERRAHİSİ YAPILAN HASTALARDA HEDEF REFRAKTİF DEĞER İLE SONUÇ REFRAKTİF DEĞERİN KARŞILAŞTIRILMASI

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ABSTRACT

Objective: To evaluate the target refractive value before and after surgery in patients who underwent phacoemulsification surgery.

Material and Method: Patients diagnosed with cataracts who underwent surgery between January 2015 and March 2017 in the Department of Ophthalmology in Istanbul University's Faculty of Medicine were accepted in this study. The difference between the target refractive value and the resulting refractive value was recorded as a refractive error.

Results: 150 eyes of 107 patients were accepted and used in this study. The SRK-T formula was applied to 100 eyes and the SRK-2 formula were applied to 50 eyes. The mean targeted refractive value was -0.21±0.17 D in the SRK-T formula group and -0.22±0.29 D in the SRK-2 formula group. The mean resulting refractive value was -0.19±0.37 D in the SRK-T formula group and -0.12±0.77 D in the SRK-2 formula group. The mean refractive error was 0.2±0.25 D in the SRK-T formula group and 0.51±0.59 D in the SRK-2 formula group. The difference between the two groups was statistically significant (p=0.001).

Conclusion: The SRK-T formula gave results which were significantly closer to the refractive target than the SRK-2 formula.

Keywords: Phacoemulsification, refraction, cataract

ÖZET

Amaç: Fakoemülsifikasyon cerrahisi uygulanan hastalarda cerrahi öncesi hedeflenen refraktif değer ile cerrahi sonrası ortaya çıkan sonuç refraktif değerin karşılaştırılması.

Gereç ve Yöntem: Katarakt tanısı ile Ocak 2015- Mart 2017 arasında İstanbul Üniversitesi İstanbul Tıp Fakültesi Göz Hastalıkları biriminde cerrahi uygulanan hastalar çalışmaya alındı. Cerrahi öncesi hedeflenen refraktif değer ile cerrahi sonrası ortaya çıkan sonuç refraktif değer arasındaki fark refraktif hata olarak kaydedildi.

Bulgular: 107 hastanın 150 gözü çalışmaya alındı. 100 gözde SRK-T, 50 gözde SRK-2 formülü kullanıldı. Ortalama hedeflenen refraktif değer SRK-T formülü uygulanan grupta -0,21±0,17 D, SRK-2 formülü uygulanan grupta -0,22±0,29 D idi. Cerrahi sonrası ortalama refraktif değer SRK-T formülü uygulanan grupta -0,19±0,37 D, SRK-2 formülü uygulanan grupta -0,12±0,77 D idi. Ortalama refraktif sapma SRK-T formülü kullanılan grupta 0,2±0,25 D iken, SRK-2 formülü kullanılan grupta 0,51±0,59 D idi ve refraktif sapma değerleri açısından iki grup arasında istatistiksel olarak anlamlı fark mevcuttu (p=0,001).

Sonuç: Fakoemülsifikasyon cerrahisi öncesi SRK-T biyometrik formülü kullanılan grupta SRK-2 biyometrik formülü kullanılan gruba göre anlamlı olarak hedeflenen refraktif değere daha yakın sonuçlar elde edildi.

Anahtar Kelimeler: Fakoemülsifikasyon, refraksiyon, katarakt

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INTRODUCTION

A cataract is a clouding of the lens in the eye which leads to a decrease in vision and may occur due to different reasons. It is most commonly acquired and rarely congenital (1,2). The treatment for cataracts is surgery and phacoemulsification surgery is the most commonly used surgical method in this condition (2,3). Vision loss is the most common indication of the need for cataract surgery (3,4). Before phacoemulsification surgery, biometry measurements are used to find the target refractive value. Essentially, biometry devices can help the ophthalmologist to identify the true intraocular lens power which will be implanted in the phacoemulsification surgery (1,3). In addition to the appropriate biometric measurement, it will be possible to minimize postoperative refractive errors with the correct surgical technique in order to achieve the targeted refractive value before surgery.

The ideal refractive status after successful phacoemulsification surgery is emetropia. However, it has been shown that intraocular lens power calculation formulas may give incorrect results in patients who have previously undergone refractive surgery. In addition, surgical technique may cause a deviation from the target refractive value for each surgeon. If a surgeon shows a constant refractive deviation in most cases, a personal constant can be added to the biometry program (1-6).

Implantation of the correct Intraocular lens (IOL) is one of the factors that affects the success of cataract surgery and ensures good visual acuity of the patient after surgery. Failure to perform appropriate IOL implantation is one of the causes of postoperative refractive problems (4-6). IOL power can be calculated with ocular biometry measurements which contain keratometric and axial length measurements (1,5). Different formulas can be used to find the optimal IOL power (1,4,5,6). The SRK-T formula is commonly used for eyes where the axial length is longer than 22 mm and the Hoffer Q formula is suitable for eyes where the axial length is shorter than 22 mm (7,8).

In this retrospective study we aimed to evaluate the difference between targeted refractive value and resulting refractive value after phacoemulsification surgery by using SRK-T and SRK-2 biometric formulas.

MATERIAL AND METHOD

The data from 308 eyes of 170 patients who underwent phacoemulsification surgery between June 2015- March 2017 was collected for the study. Exclusion criteria were: astigmatism higher than [0.50] diopter before surgery, complications pertinent to phacoemulsification surgery, corneal disease, pseudoexfoliation, glaucoma, uveitis, previous ocular surgery or trauma and posterior segment disorder (macular edema due to diabetic retinopathy, irvine gass syndrome, retinal vascular occlusion etc. or subretinal fluid due to age related macular degeneration which may effect the autorefractometer measurements were excluded the study). Furthermore, patients with extended anterior chamber inflammation or patients who remained on steroids at 1 month after surgery and who could not come to follow-up visits for at least 3 months were excluded from the study. Finally, 150 eyes of 107 patients were accepted in this study.

Approval was obtained from the ethics committee of Istanbul University Istanbul Faculty of Medicine. Informed consent was obtained from all patients.

The study was designed as a retrospective case series. The following data was collected and recorded: gender of the patients who underwent surgery, age at the time of surgery, date of surgery, eye side on surgery, best corrected visual acuity before surgery, presence of concomitant ocular disease, anterior segment examination under the biomicroscope, type and degree of cataract, and measurement of intraocular pressure using an applanation tonometer.

The best corrected visual acuities (BCVA) were measured with LogMAR 1 day, 1 week, 1 month and 3 months after surgery. Biometric analyses were made using an IOL Master 500 device (Carl Zeiss AG, Germany) and the targeted refractive values were recorded (the measurements were made by the same staff to avoid interobserver variations). The IOL power calculation was made for AcrySof IQ (SN-60WF) IOL (Alcon Laboratories, Inc.) which was implanted in all of the patients in the study. Two different biometric formulas were used in the study. The first one was the SRK-T formula which was used in 100 eyes and the second was the SRK-2 formula which was used in 50 eyes in the study. Emetropia or minimal miyopia was the target result in the patients. We obtained the target refraction value by using the biometric measurement results. In all cases, the phacoemulsification surgery was completed successfully and the AcrySof IQ IOL (Alcon Laboratories, Inc.) was implanted in all patients. The Infiniti vision system (Alcon, Inc.) was used in all surgeries. 'Stop and chop' or 'chip and flip' phaco techniques were used in all surgeries by the same experienced surgeon. No corneal suturation was needed in the surgeries and temporal 2.4 mm corneal incision was performed in all cases.

In the postoperative period, tobramycin eye drops were prescribed 4 times daily for one week and prednisolone sodium phosphate eye drops were prescribed 4 to 6 times for 4 weeks. The spherical equivalent of the refractive value was calculated at the end of the third month after surgery.

The Statistical Package for the Social Sciences version 22.0 (SPSS Inc., Chicago, IL, USA) was used to analyse the statistical tests, and a p value <0.05 was considered to be significant. All data was given with mean, standard deviation, and minimum and maximum value The chi-squared test was used to compare the nominal data. The distribution of data was examined using the Kolmogorov-Simirnov test. The Anova or t-test were used to compare data with a normal distribution. The Mann Whitney-U and Kruskal Wallis test were used to compare data with an abnormal distribution. The Friedmann variance analysis and Wilcoxon test were used to compare recurrent measurements.

RESULTS

One hundred fifty eyes of 107 patients were accepted in this study. Fifty five patients were women and 52 patients were men in the study. The mean age of patients was 65.79±10.94 [23-89]. The mean implanted IOL diopters (D) were 21.53±1.99 D [15.5-27 D] in the study. The mean BCVA of cases were 0.6±0.37 [0.22-2] LogMAR before surgery. At the first day after surgery, the mean BCVA were 0.33±0.3 [0-1.7] LogMAR. The mean BCVA were 0.13±0.14 [0-1] LogMAR at the first week postoperatively. At the first month after surgery, the mean BCVA were 0.05±0.09 [0-0.5] LogMAR. At the third month after surgery, the mean BCVA were 0.03±0.07 [0-0.4] LogMAR in the study. The increase of BCVA after surgery was statistically significant (p<0.001). BCVA changes between controls were significant (p<0.001) except for between 1 and 3 months controls (p>0.05) in the study (Friedmann variance analysis).

The mean targeted refractive value was -0.21±0.22 D [-0.77 D±0.9 D] preoperatively. The resulting refractive value was -0.17±0.54 D [-4.25 D±1.25 D] postoperatively. Thus, the mean refractive error was found to be 0.3±0.43 D [0-3.95] in the study. The average axial length of the eyes was 23.45±0.9 [21.21-25.66] mm in the study. Twenty eyes had a short axial length and 21 eyes had a long axial length in the study. 109 eyes were in the normal range of axial length (22.0-24.5 mm).

The accompanied ocular findings are shown in Table 1. Age related macular degeneration (ARMD) was seen in 14 patients. Seven ARMD patients were in the SRK-T group and 7 ARMD patients were in the SRK-2 group and there was no difference between two groups (p=0.990, Chi square test). Seven patients had background diabetic retinopathy. Three patients were in the SRK-T group and 4 patients were in the SRK-2 group and there was no difference between the two groups (p=0.758, Chi square test). Glaucoma was seen in 7 patients. Four patients

Table 1: Accompanied ocular findings in patients who underwent phacoemulsification surgery

Ocular findings	Number of patient
ARMD	14 (%13,1)
DRP	7 (%6,5)
GLAUCOMA	7 (%6,5)
ERM	1 (%0,9)

ARMD: Age related macular degeneration
DRP: Diabetic retinopathy ERM: Epiretinal membrane.

Table 2: Evaluation of the SRK-T and SRK-2 formula groups before cataract surgery in terms of BCVA and refractive results.

	SRK-T	SRK-2	p value
Number of patients	100	50	-
Gender (men/women)	36 / 39	16 / 16	-
Mean age	65.08±11.7	65.6±9.8	0.939
Mean axial length	23.5±1.04 mm	23.35±0.53 mm	0.331
Mean IOP before surgery	14.9±1.8 mm Hg	14.5±1.7 mm Hg	0.200
Mean IOP at 3.month after surgery	13.5±1.67 mm Hg	13.8±1.86 mm Hg	0.273
Mean BCVA before surgery	0.61±0.36 LogMAR	0.59±0.42 LogMAR	0.824
Mean BCVA 1.day after surgery	0.31±0.30 LogMAR	0.36±0.31 LogMAR	0.374
Mean BCVA 1.week after surgery	0.11±0.10 LogMAR	0.18±0.19 LogMAR	**0.009**
Mean BCVA 1.month after surgery	0.03±0.07 LogMAR	0.08±0.11 LogMAR	**0.005**
Mean BCVA 3.month after surgery	0.02±0.06 LogMAR	0.05±0.09 LogMAR	**0.009**
Average targeting refractive value	-0.21±0.17 D	-0.22±0.3 D	0.744
Average resulting refractive value	-0.19±0.37 D	-0.12±0.78 D	0.576
Average refractive error	0.2±0.25 D	0.5±0.6 D	**0.001**

were seen in the SRK-T group and 3 patients were seen in the SRK-2 group and there was no difference between two groups (p=0.758, Chi square test). Epiretinal membrane was seen in only one patient.

The refractive results, ocular findings and demographic data are shown in Table 2. The patients were divided into two groups. The SRK-T formula was applied to 100 eyes, the SRK-2 formula was applied to 50 eyes in the study. There were 36 men, 39 women in the SRK-T group and 16 men, 16 women in the SRK-2 group. The mean age was 65.08±11.7 [35-89] in the SRK-T group and 65.6±9.8 [47-83] in the SRK-2 group. There was no statistically significant difference between the two groups (p=0.939, Independent t-test). The mean axial length in the SRK-T group was 23.5±1.04 [21.21-25.26] mm and in the SRK-2 group was 23.35±0.53 [22.26-24.41] mm, there wasn't any statistically significant difference between the two groups (p=0.331, Independent t-test). The mean IOP before surgery was 14.9±1.8 [10-20] mm Hg in the SRK-T group and 14.5±1.7 [11-18] mm Hg in the SRK-2 group. The average IOP at 3 months after surgery was 13.5±1.67 [10-17] mm in the SRK-T group and 13.8±1.86 [11-19] mm Hg in the SRK-2 group. There was no difference between the two groups in terms of IOP values before and after surgery. (p=0.200 and 0.273 respectively, Mann Whitney U test). A decrease of IOP after surgery was statistically significant in the two groups (p=0.017 in the SRK-T group and p=0.010 in the SRK-2 group, One sample t-test).

The mean BCVA before surgery was 0.61±0.36 [0.22-2] LogMAR in the SRK-T group and 0.59±0.42 [0.22-2] LogMAR in the SRK-2 group. There was no significant difference between the two groups. (p=0.824, Independent t-test). The mean BCVA was 0.31±0.30 [0-1.7] LogMAR in the SRK-T group and 0.36±0.31 [0-1.3] LogMAR in the SRK-2 group at the first day after surgery. No significant difference was seen between the two groups (p=0.374, Independent t-test). The average BCVA was 0.11±0.10 [0-0.5] LogMAR in the SRK-T group and 0.18±0.19 [0-0.7] LogMAR in the SRK-2 group at the first week postoperatively. There was a significant difference between the two groups (p=0.009, Independent t-test). At 1 month after surgery, the mean BCVA was 0.03±0.07 [0-0.3] LogMAR in the SRK-T group and 0.08±0.11 [0-0.4] LogMAR in the SRK-2 group. There was a significant difference between the two groups (p=0.005, Independent t-test). The mean BCVA was 0.02±0.06 [0-03] LogMAR in the SRK-T group and 0.05±0.09 [0-0.4] LogMAR in the SRK-2 group at 3 months after surgery. There was a significant difference between the two groups (p=0.009, Independent t-test).

The average target refractive value was -0.21±0.17 D in the SRK-T group and -0.22±0.3 D in the SRK-2 group in the study. There was no significant difference between the two groups in terms of the mean target refractive values (p=0.744, Mann Whitney U test). The average resulting refractive value was -0.19±0.37 D in the SRK-T group and -0.12±0.78 D in the SRK-2 group. There was no significant difference between the two groups (p=0.576, Mann Whitney U test). The average refractive error was 0.2±0.25 D in the SRK-T group and 0.5±0.6 D in the SRK-2 group and there was a statistically significant difference between the two groups (p=0.001, Mann Whitney U test).

We evaluated the relationship between the refractive error and axial length of patients. Refractive error was significantly higher in eyes which had a shorter axial length than the normal and long axial length (p=0.002 and 0.010 respectively, Kruskal Wallis test). There was no difference between the eyes which had normal and long axial length in terms of refractive error (p=0.926, Kruskal Wallis test).

DISCUSSION

Thanks to the developing biometric devices and formulas, it has become possible to reach the targeted refractive results after phacoemulsification surgery (9). Today, one of the most important goals of cataract surgery is to achieve the desired refractive result (10-12).

Optical biometry-based devices, which are frequently used in clinical practice for biometric measurements, allow the calculation of IOL power with different formulas in different eyes in a short time. Today, IOL Master (Carl Zeiss AG, Germany) and Lenstar LS 900 (Haag-Streit USA) devices are commonly used for optical biometric measurements (5,7).

Afsun et al. recommended that the software of the new IOL Master device should be upgraded, the signal reception should be strengthened and its reproducibility increased. In addition, the most effective intraocular lens position is provided by modern IOL power calculation formulas and the IOL power estimation is closer to the true value (9).

Hui et al. stated that new generation optical biometry devices can be used safely in the preoperative examination of cataract surgery in their study (13). Suto et al. compared different optical biometry devices in their study and found no difference between them in terms of achieving the ideal refractive result. In addition, the SRK-T and Haigis formula and Camellin-Calossi IOL power calculation formula were compared and Camellin-Calossi formula, a new generation IOL power calculation formula, was found to be successful in predicting the refractive result like the commonly used IOL power calculation formulas in their study (14). In our study, with the SRK-T and SRK-2 biometric formulas, a large proportion of patients had refractive deviation within 0.50 D postoperatively. However, in patients on whom the SRK-T formula was used, the postoperative refractive results were closer to emetropia.

Kaya et al. evaluated the SRK-T and SRK-2 biometric formulas in eyes with a short axial length in their study. As a result, the SRK-T formula was found better at achieving target refraction but neither the SRK-T nor the SRK-2 formula were ideal in eyes with a short axial length (15). Similarly, more successful results were obtained in providing target refraction with the SRK-T formula but refractive error was higher in patients who had a shorter axial length than the normal and long axial length in our study.

Jeong et al. showed that the use of the Hoffer Q formula in eyes with a short axial length yielded more successful results than using the SRK-T and SRK-2 formulas. In our study, the number of eyes which were used Hoffer Q formula for IOL power calculation before phacoemulsification surgery was limited to 8 eyes of 6 patients and these cases were not included in the study. It is obvious that more cases should be compared by using all these biometric formulas for IOL power calculation before cataract surgery and this is one of the limitations of our study.

Oderinle et al. evaluated targeted refractive values before phacoemulsification surgery and short term visual results after phacoemulsification surgery in their study. At the end of the three months follow-up, 85% of cases were within ± 1 D resulting refractive values in their study (16). In our study, 96% of eyes were within ± 1 D resulting refractive values.

Poley et al. evaluated the patients which were under glaucoma treatment and had undergone phacoemulsification surgery in their study. They showed that the mean IOP decreased to 2.7 mm Hg (17). In our study, we demonstrated that the mean IOP was decreased significantly after phacoemulsification surgery ($p<0.001$).

CONCLUSION

Our study showed that the SRK-T formula is significantly more successful in reaching the target refractive results than the SRK-2 formula after phacoemulsification surgery and the success of the achieving the targeted refractive value is also dependent on the axial length of the eye which is operated on.

Ethics Committee Approval: Ethics committee approval was received for this study.

Informed Consent: Written consent was obtained from the participants.

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