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Clinical Outcomes in Myopic Patients with Refractive Lens Extraction and Posterior Chamber Intraocular Lens Implantation

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ABSTRACT

Objective: This study aimed to share our clinical results in myopic patients who underwent refractive lens extraction and posterior chamber intraocular lens implantation (RLE + PCIOL).

Material and Methods: The data of myopic patients who underwent RLE + PCIOL implantation in our clinic between January 2004 and December 2009 were reviewed retrospectively. Preoperative and postoperative best uncorrected distance visual acuity (UDVA), best corrected distance visual acuity (CDVA), refractive status, axial length (AL), biometric measurement, deviation from target refraction, and complication data were analyzed. The Sanders-Retzlaff-Kraff (SRK) II formula was used for preoperative intraocular lens (IOL) calculations. Measurements were repeated with Sanders-Retzlaff-Kraff-Theoretical (SRK-T) and Hoffer Q formulas using preoperative data, and the results were compared with SRK II.

Results: Ninety-eight eyes of 57 myopic patients were included. Mean age was 37.91 ± 11.68 (18-59) years, and mean follow-up period was 35.12 ± 21.34 (6-78) months. Their AL was higher than 26.0 mm and their spherical value (SV) was higher than -8.00 diopters (D). There was significant improvement in UDVA, CDVA, SV, and spherical equivalent data at postoperative one month compared to preoperatively (all p< 0.001). Deviation from the target refraction was within the range of ± 1.00 D in 70 eyes (73.6%). A positive correlation was found between AL and deviation from target refraction (r= 0.359, p= 0.001). Within the formulas, deviation from the target refraction was lower with SRK II (r= -0.371, p< 0.001).

Conclusion: Despite the risks of serious complications RLE + PCIOL implantation is a rapid and effective method in the visual rehabilitation of degenerative myopia. Degenerative myopic patients, especially those who have cataractous changes in the clear lens, and who are presbiyopic or approaching the presbyopic age, are more suitable candidates.

Keywords: Refractive lens exchange, degenerative myopia, retinal detachment, posterior staphyloma

ÖZ

Refraktif Lens Değişimi ve Arka Kamara Göz İçi Lens İmplantasyonu Yapılan Miyopik Hastalarda Klinik Sonuçlarımız

Giriş: Refraktif lens değişimi ve arka kamara göz içi lens implantasyonu (RLD + AKGİL) yapılan miyopik hastalarımızdaki klinik sonuçlarımızın paylaşılmasıdır.

Gereç ve Yöntemler: Ocak 2004-Aralık 2009 arasında kliniğimizde RLD + AKGİL implantasyonu yapılan miyopik hastaların verileri retrospektif olarak incelendi. Preoperatif ve postoperatif döneme ait düzeltilmemiş en iyi görme keskinliği (DEİGK), en iyi düzeltilmiş görme keskinliği (EİDGK), refraktif durum, aksiyel uzunluk (AU), biyometrik ölçüm, hedef refraksiyondan sapma, biyomikroskobik muayene ve komplikasyon verileri tarandı. Preoperatif göz içi lens (GİL) hesaplamaları için Sanders-Retzlaff-Kraff (SRK) II formülü kullanılmıştır. Hedef refraksiyon değeri, hastaların yakın-uzak görme tercihlerine göre belirlenmiştir. Preoperatif veriler kullanılarak Sanders-Retzlaff-Kraff-Theoretical (SRK-T) ve Hoffer Q formülleri ile ölçümler tekrarlandı ve sonuçlar SRK II ile karşılaştırıldı.

Bulgular: Elli yedi miyopik hastanın 98 gözü dahil edildi. Yaş ortalamaları 37,91 ± 11,68 (18-59) yıl, ortalama takip süresi 35,12 ± 21,34 (6-78) aydı. Aksiyel uzunlukları 26,0 mm'den, sferik değerleri (SD) -8,00 diyoptriden (D) yüksekti. Postoperatif birinci ayda DEİGK, EİDGK, SD ve sferik eş değer (SED) verilerinde ameliyat öncesine göre anlamlı düzelme tespit edildi (tamamında p< 0,001). Hedef refraktif değerden sapma 70 gözde (%73,6) ± 1,00 D aralığındaydı. Aksiyel uzunluk ve hedef refraksiyondan sapma arasında pozitif korelasyon saptandı (r= 0,359, p= 0,001). Formüller içinde hedef refraksiyondan sapmanın SRK II ile daha düşük olduğu görüldü (r= -0,371, p< 0,001).

Sonuç: Endoftalmi ve retina dekolmanı gibi ciddi komplikasyon riskleri taşımasına rağmen RLD + AKGİL implantasyonu dejeneratif miyopinin görsel rehabilitasyonunda hızlı ve etkili bir yöntemdir. Özellikle şeffaf lenste katarakatöz değişiklikleri başlayan, presbiyopik veya presbiyopik çağa yaklaşmış dejeneratif miyopik hastalar daha uygun adaylardır.

Anahtar Kelimeler: Refraktif lens değişimi, dejeneratif miyopi, retina dekolmanı, posterior stafilom

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INTRODUCTION

Myopia is a very common refractive error caused by a mismatch between the axial length (AL) of the eye and the refractive power (1). Degenerative myopia (DeM) is almost always characterized by a progressive increase in the axial length of the eye and degenerative changes in the retina. In contrast to physiologic myopia, which stabilizes at 15-16 years of age, progression in DeM continues until the third decade (2). Degenerative myopia may present with increased AL due to congenital scleral weakness, posterior staphyloma, vitreous effusion, progressive atrophy of the choroid and choriocapillaris, bruch's membrane cracks (lacquer cracks), retinal thinning and atrophy (3).

The treatment of high myopia has been a subject of interest, especially since it affects the young and productive generation. Although refractive corneal surgeries achieve a range of application up to (-12.0)/(+6.0) diopters (D), refractive lens surgery is recommended for patients above these numbers and for candidates who are not suitable for refractive corneal surgery (4). In refractive lens exchange (RLE), intraocular lens (IOL) implantation is performed after removal of the clear lens (since the drawbacks of leaving patients aphakic are well known). IOLs are important for visual rehabilitation, vitreous support and preservation of normal anatomy (5).

Our study includes patients with degenerative myopia in whom we applied RLE + posterior chamber (PC)-IOL implantation. With this study, we aimed to present the visual acuity, refractive changes, deviation from the target spherical value and complications of these patients. We think that this study may be useful in clinical practice to provide preoperative and postoperative guidance to clinicians who will perform this relatively rare surgery.

MATERIALS and METHODS

This retrospective study included myopic patients who underwent RLE + PC-IOL implantation in our clinic between January 2004 and December 2009. Approval for the study was obtained from Erciyes University Faculty of Medicine Clinical Research Ethics Committee (Approval number: 2010/02). Informed consent form was obtained from the patients included in the study.

The study included 98 eyes of 57 patients. Patients who were younger than 18 years of age, had a preoperative spherical value below -8.00 D, had previous intraocular surgery, had lattice degeneration of 180 degrees or more, had myopic maculopathy, and had no postoperative follow-up of at least six months were excluded. Best uncorrected visual acuity (UDVA), best corrected visual acuity (CDVA), refraction (Nidek ARK-700 A/ Canon Full Auto Ref R-F10), keratometry (Nidek ARK-700A), biomicroscopic examination, (Haag Streit Bern/Sweden- L-5110, Inami & Co, Ltd., JAPAN Ophthalmic Ins.), intraocular pressure (IOP, Goldman applanation tonometer), AL (A scanning contact ultrasound -USG- method, Sonomed A-2000) and biometry (Sanders-Retzlaff-Kraff -SRK- II formula) data were screened. Informed consent forms for the surgical procedure were available. The RLE procedure and preoperative preparations were similar to routine phacoemulsification surgery. Surgeries were performed under general, retrobulbar, peribulbar and topical anesthesia. Biometry measurements using Sanders-Retzlaff-Kraff-Theoretical (SRK-T) and Hoffer Q formulations (Ultrascan; Alcon, Fort Worth, Texas, USA) were repeated using the patients' preoperative data, and the results were compared with SRK II.

In our clinical practice, patients' activities in daily life, their education, and whether they drive or not were taken into consideration for planning the emmetropia or ametropia needed postoperatively. In the under forty age group, if the patient prefers near vision, myopia was targeted to be -1.00/-1.50/-2.00 D in at least one eye. For the other eye where monovision requires emmetropia, a myopia of -0.50/-1.00 or -1.50 D was planned to avoid a possible hyperopia. In the patient with a preference for distance vision, emmetropia was targeted to a lesser extent, often with a myopia of -0.50/-0.75. For patients over the age of forty, either ametropia of -1.00/-1.50/-2.00 D in both eyes or full monovision (taking into account the possible hypermetropic shift since this group is more ready to wear glasses) was planned according to the patient's preferences. For patients who cared more about distance vision, both eyes were planned with -0.50 D myopia.

Statistical Analysis

SPSS for Windows 15.0 (SPSS 15.0 Inc Chicago, IL) and SigmaStat 3.5 statistical package programs were used to evaluate the data. The Shapiro Wilk test was used to evaluate whether the numerical data fit the normal distribution. Nonparametric tests were used for data that did not conform to normal distribution, and data that did not conform to normal distribution were expressed as median 25%-75% percentiles and minimum and maximum values. Wilcoxon sign test was used for pairwise comparisons of preoperative and postoperative values and Friedman analysis of variance was used for comparisons of more than two data. In case of a difference in Friedman's analysis of variance, Tukey test, one of the POST-HOC tests, was used to determine the source of the difference. The relationship between the values was evaluated by Spearman correlation analysis. In

the evaluation of repeated measurements, Friedman's analysis of variance was followed by the Tukey test, which is one of the POST-HOC tests. Friedman's analysis of variance was used to compare the spherical value and spherical equivalent preoperative, early postoperative and postoperative control values, and Tukey's test, a POST-HOC test, was used to determine the source of the difference. The nonparametric Mann-Whitney U test was used to compare hydrophobic and hydrophilic IOLs according to the presence of posterior capsular opacification. Pearson Chi-square test was used to compare gender according to the posterior capsule opacification in hydrophobic and hydrophilic IOLs. $p< 0.05$ was accepted for statistical significance.

RESULTS

The study included 56 eyes of 32 female patients (56.1%) and 42 eyes of 25 male patients (43.9%), totaling 98 eyes of 57 patients. Forty-one (72%) of the patients underwent surgery in both eyes and 16 (28%) in one eye. Mean age of the patients was 37.91 ± 11.68 (18-59) years, and mean follow-up period was 35.12 ± 21.34 (6-78) months. Mean AL was greater than 26.0 mm, and mean spherical value (SV) was greater than -8.00 D. Three patients had controlled hypertension and one had controlled diabetes mellitus. Prophylactic argon laser retinopexy was performed in 19 eyes (19.3%) preoperatively for peripheral retinal degeneration areas. Surgery was postponed for at least three weeks in patients who underwent prophylactic laser retinopexy. In all patients, IOP was between 10-20 mm Hg preoperatively (three patients with antiglaucomatous drops).

There was a significant improvement in SV and spherical equivalent (SE) compared to preoperative values both at postoperative first month and at the last follow-up ($p< 0.001$). Mild myopic progression was observed in the final control data compared to postoperative first month although not statistically significant. There was a significant difference between the preoperative period, postoperative first month and last follow-up in UDVA and CDVA data ($p< 0.001$). There was no significant difference between postoperative first month and last follow-up. The preoperative and postoperative comparison of SV, SE, UDVA and CDVA data are given in Table 1.

Postoperative AL values were significantly higher than preoperative values ($p= 0.008$). There was no significant difference between the values for flat keratometry (K1) and vertical keratometry (K2) ($p= 0.676$). Preoperative and postoperative comparisons of AL, K1 and K2 data are given in Table 2.

At the first postoperative month evaluation, 70 eyes (73.6%) were within ± 1.00 D deviation from the target. Twelve eyes (12.7%) had a negative deviation of more than -1.00 D from the target, while 13 eyes (13.7%) had a positive deviation of more than +1.00 D from the target. There was a positive correlation between AL and deviation from target refraction ($r= 0.359$, $p= 0.001$).

Retinal detachment (RD) developed in one eye (1%) at seven months and choroidal neovascular membrane (CNVM) developed in three eyes (3.1%) at six and 36 months. One eye (1%) developed retinal tear, and argon laser retinopexy was performed. Nine eyes (9.2%) required laser retinopexy around atrophic and peripheral retinal degenerations. Twenty eyes (20.4%) underwent neodium ytrium aluminum oxide garnet (Nd:YAG) laser capsulotomy for posterior capsular opacification (PCO). Forty-seven eyes (48%) were implanted with hydrophobic acrylic IOL and 51 eyes (52%)

Table 1. Preoperative and postoperative comparison of SV, SE, UDVA and CDVA data

Variable	Preoperative Median (25p%-75p%) (min-max)	Postoperative one month Median (25p%-75p%) (min-max)	Last follow up Median (25p%-75p%) (min-max)	p
SV	-17.0 (-13.0/-19.0)[a] (-8.0 and -25.0)	-0.25 (0.0/-1.0)[b] (-3.0 and + 3.0)	-0.65 (0/-1.25)[b] (-3.25 and + 3.0)	<0.001*
SE	-18.33 (-14.25/-20.25)[a] (-8.5 and -25.0)	-0.88 (-0.35/-1.5)[b] (-3.75 and + 2.75)	-1.25 (-0.50/-1.75)[b] (-3.75 and +2.75)	<0.001*
UDVA Snellen	0.02 (0.01-0.03)[a] (0.01-0.2)	0,4 (0.2-0.5)[b] (0.01-0.9)	0.4 (0.2-0.5)[b] (0.01-0.9)	<0.001***
CDVA Snellen	0.3 (0.2-0.4)[a] (0.02-0.8)	0.6 (0.5 -0.7)[b] (0.05-1.0)	0.6 (0.4 -0.7)[b] (0.05-1.00)	<0.001***

Med (25p%-75p%): Median, 25th percentile and 75th percentile values,*p< 0.001.
Same letters indicate similarity between groups, different letters indicate difference between groups. SV: Spherical value, SE: Spherical equivalent, UDVA: Best uncorrected visual acuity, CDVA: Best corrected visual acuity.

Table 2. Preoperative and postoperative comparison of AL, K1 and K2 values

Variable	Preoperative Median (25p%-75p%) (min-max)	Last follow up Median (25p%-75p%) (min-max)	p
K1 (D)	43.0 (42.06-44.0) 38.5-45.5	43.0 (42.25-44.19) 38.5-45.25	0.221
K2 (D)	44.4 (43.0-45.44) 38.7-48.3	44.5 (43.5-45.5) 38.7-48.3	0.676
AL (mm)	29.93 (28.23-31.19) 26.0-33.91	30.3 (28.26-31.19) 26.13-37.11	0.008*

Med (25p%-75p%): Median, 25th percentile and 75th percentile values.
*K1: Flat keratometry, K2: Steep keratometry, D: Diopter, AL: Axial length.

Table 3. Correlations of formulas with deviation from target

	SRK II	SRK-T	Hoffer Q
Deviation from target	-0.371*	-0.311*	-0.317*

* Correlation is significant at 99% level.

Table 4. Comparison of SRK II, SRK-T and Hoffer Q formulas according to IOL power

Variable	SRK II Median (25p%-75p)	SRK-T Median (25p%-75p)	Hoffer Q Median (25p%-75p)	p
IOL power	3.5 (0.5-7)[a]	2.5 (0-6)[b]	2.25 (-0.75- 6)[c]	<0.001

Med (25p%-75p%): Median, 25th percentile and 75th percentile values,*p< 0.001.
Same letters indicate similarity between the groups, different letters indicate difference between the groups. IOL: Intraocular lens.

with hydrophilic acrylic IOL. Multifocal IOLs were implanted in two eyes (2%) of one patient and monofocal IOLs were implanted in the other 96 eyes (98%).

SRK II formula was used for IOL calculations of the patients. Using the preoperative data, measurements were also made according to the SRK-T and Hoffer Q formulas and the data were compared within themselves. The correlations of the formulas with the deviation from the target refraction are given in Table 3. The correlations of the formulas with the deviation from the target are weak negative correlations. The deviation from the target was lower in SRK II (r= -0.371, p< 0.001).

When the medians of IOL calculations with the three formulas were compared, the values calculated with SRK-T and Hoffer Q were statistically different from those calculated with SRK II (p< 0.001). SRK T and Hoffer Q IOL medians are smaller than SRK II (Table 4).

In our study, there were 34 patients in the age group before the age of presbyopia and 23 patients over the age of 40. In the pre-presbiyopic age group, nine of the patients had undergone monocular surgery, the other eye was phakic, and they were using accommodation of the phakic eye. During follow-up, 10 patients (18.9%) needed spectacles for near only, five patients (9.4%) needed spectacles for distance only, and 21 patients (39.6%) needed spectacles for both near and distance.

DISCUSSION

DeM is an important pathology because of its early onset, which causes visual impairment in young and socially active patients (1). RLE surgery has become prominent in high myopic patients for whom refractive corneal surgery is not suitable (6). RLE is more appropriate in young patients who are presbyopic or approaching the age of presbyopia, especially in patients with cataractous changes in the lens, because it causes loss of accommodation. In addition to the benefits of emmetropia after RLE, early onset of presbyopia makes the patient dependent on spectacles or contact lenses. However, pre-presbyopic patients who are anisometropic and will remain phakic in the other eye (as in our nine patients before the age of 40) are suitable candidates for this surgery because they can use the accommodation of the other eye.

In our study, RLE + PC-IOL implantation resulted in a significant decrease in refraction and a significant increase in

visual acuity. The fact that there was no significant changes in refractions at the end of a mean follow-up period of 35 months suggests that RLE surgery provides a stable refraction. Target refraction values were planned considering the needs of the patient in the postoperative period. It is difficult to achieve complete emmetropia or complete monovision in these patients because of their high refractive deviation rates. A moderate monovision with residual myopia may be beneficial in this patient group. Finkelman et al. aimed for moderate monovision in 52 eyes of 26 patients without degenerative myopia who underwent routine cataract surgery (7). They targeted emmetropia in the dominant eye and -1.00/-1.50 D refraction in the fellow eye. They reported that postoperative stereopsis, contrast sensitivity and patient satisfaction were quite good (7).

Postoperative AL values were significantly increased compared to preoperative values and mild myopic progression was observed in the last controls. This may be due to the fact that DeM progresses until the third decade without stabilizing (2). In fact, 49 eyes (50%) in our study belonged to patients aged 35 years and younger. In addition, this difference may be due to staphyloma progression in patients with staphyloma. Hsiang et al. reported that posterior staphylomas worsen morphologically as patient age increases (8).

Deviation from the target SV was in the range of ± 1.00 D in 70 eyes (73.64%). There was also a positive correlation between AL and deviation from the target. Similarly, Vicary et al. have reported a deviation rate of ± 1.00 D from emmetropia of 78.3%; in this study, A scan USG was used for AL measurement, and SRK II formula was used for IOL power calculation (9). The main causes of refractive deviation are inaccurate biometry, inaccurate keratometry and inappropriate IOL formula. Corneal compression during AL measurement and the presence of posterior staphyloma are also important sources of error (10). In patients with staphyloma, it is useful to inform the technician about the presence and location of staphyloma, to perform A and B scan USG examinations together, and to compare multiple measurements from two eyes. In addition, in this study, the deviation from the target was found to be lower with the SRK II formula than SRK-T and Hoffer Q. There are also studies recommending Haigis and SRK-T formula for optical biometry in DeM (10,11).

CNVM developed in three eyes (3.1%) in the postoperative period. Secondary inflammatory process due to surgery, inhibition of blue light blockade and angiogenic factors triggered by altered choroidal hemodynamics during surgery have been reported as the causes of CNVM after RLE surgery (12,13). RD was observed in one eye (1%) during follow-up. The patient had no predisposing lesion or argon laser application. RD rates ranging up to 8.1% after RLE have been reported (14-18). An increased risk of RD has been reported in patients who underwent preoperative argon laser (18). It is not clear whether the detachment is due to the inadequate preventive effect of the argon laser or the triggering of posterior vitreous detachment by the laser (18). In addition, Nd:YAG laser capsulotomy procedure used in the treatment of postoperative PCO has also been found to increase the risk of RD (19). There are theories that retinal tears may occur due to the direct effect of Nd:YAG laser or laser waves may cause vitreous licefaction and posterior vitreous detachment (19). In these patients, cortex cleaning should be performed well during surgery to reduce the risk of PCO formation.

CONCLUSION

In conclusion, RLE + PC-IOL provides a rapid and effective visual rehabilitation in patients with DeM. Presbyopic patients or patients approaching the age of presbyopia are more suitable candidates, but good results can also be achieved in motivated young patients. Postoperative refraction goals should be determined according to the patient's age and near or distance needs. Attention should be paid to AL measurement and IOL formulation selection. Close control of the retina and vitreous is necessary preoperatively and postoperatively.

Ethics Committee Approval: This study was approved by the Erciyes University Faculty of Medicine Clinical Research Ethics Committee (Decision no: 2010/02, Date: 15.04.2010).

Author Contributions: Concept/Design: DTE, KE; Analysis/Interpretation: DTE, KE; Data Acquisition: DTE, KE; Writing: ASA, DTE; Critical Revision: All of authors; Final Approval: All of authors.

Conflict of Interest: All authors declare that they have no conflict of interest.

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