ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

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An Analytical Study on Intraocular Lens Power Calculation Using Different Formulas Before and After Upper Eyelid Blepharoplasty in Patients with Visual Field Defects Due to Dermatochalasis

Dermatoşalazis Nedeniyle Görme Alanı Defekti Olan Hastalarda Üst Göz Kapağı Blefaroplasti Öncesi ve Sonrası Farklı Formüllerle İntraoküler Lens Gücü Hesaplanmasına Yönelik Analitik Çalışma

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ABSTRACT Objective: This study aims to evaluate the changes in intraocular lens (IOL) power calculations using different formulas before and after upper eyelid blepharoplasty in patients with visual field defects due to dermatochalasis. **Material and Methods:** A total of 166 eyes from 166 patients with superior visual field narrowing due to dermatochalasis were included in this prospective study. Keratometric measurements and IOL power calculations were assessed at baseline and during postoperative follow-ups using Nidek optical biometry (AL-Scan, Nidek Co., Ltd., Japan). **Results:** The study included 166 eyes of 166 patients, 85.5% of whom were female and 14,5% male. The mean age of females was 56.80±9.73 years (range 37-78), and for males, it was 55,91±7.95 years (range 44-68). There were no significant differences in the measurements of average and steepest corneal curvature or corneal astigmatism (p>0.05). However, significant differences were found in the IOL power calculations using different formulas [Sanders-Retzlaff-Kraff-Theoretical (SRT-T), Hoffer, Holladay, and Haigis] before and after surgery (p<0.000). **Conclusion:** To the best of our knowledge, the current study is the first to explore this topic with multiple IOL formulas and a larger sample size.

Keywords: Blepharoplasty; intraocular lens formula; keratometry; optical biometry

ÖZET Amaç: Bu çalışma, dermatoşalazis nedeniyle görme alanı daralması olan hastalarda üst göz kapağı blefaroplastisi öncesi ve sonrası farklı formüllerle yapılan göz içi lens (GİL) gücü hesaplamalarındaki değişiklikleri değerlendirmeyi amaçlamaktadır. **Gereç ve Yöntemler:** Dermatoşalazis nedeniyle üst görme alanı daralması yaşayan toplam 166 hastanın 166 gözü, bu prospektif çalışmaya dâhil edilmiştir. Keratometrik ölçümler ve GİL gücü hesaplamaları, ameliyat öncesi ve ameliyat sonrası takiplerde Nidek optik biyometri cihazı (AL-Scan; Nidek Co., Ltd., Japan) kullanılarak değerlendirilmiştir. **Bulgular:** Çalışmaya 166 hastanın 166 gözü dâhil edilmiştir. Hastaların %85,5'i kadın, %14,5'i erkekti. Kadınların ortalama yaşı 56,80±9,73 (37-78), ve erkeklerin ise 55,91±7,95 yıl (44-68) olarak bulunmuştur. Ortalama ve en dik kornea eğriliği ile korneal astigmatizm ölçümlerinde anlamlı bir fark bulunmamıştır (p<0.05). Ancak, ameliyat öncesi ve sonrası farklı formüllerle [Sanders-Retzlaff-Kraff-Theoretical (SRK-T), Hoffer, Holladay ve Haigis] yapılan GİL gücü hesaplamalarında anlamlı farklılıklar tespit edilmiştir (p<0,000). **Sonuç:** Bildiğimiz kadarıyla bu çalışma birden fazla GİL formülü ve daha büyük örneklem boyutu ile bu konuyu inceleyen ilk araştırma olma özelliğini taşımaktadır.

Anahtar Kelimeler: Blefaroplasti; göz içi lens formülü; keratometri; optik biyometri

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Dermatochalasis refers to the excess skin on the upper eyelid resulting from a loss of elasticity due to aging.[1-3] In some cases it may be accompanied by prolapse of the orbital septum and connective tissue.[4,5]

With increasing the life expectancy, quality of life, and societal standarts, there has been a growing demand for surgical procedures targeting the facial region. The prevalence of dermatochalasis in individuals over the age of 45 is reported to be 16%, with a higher rate in males (19%) compared to females (14%).[1,5-7]

The marginal reflex distance (MRD) is highest between the ages of 20 and 29, with a progressive decline occuring after this age. However, the most significant narrowing of MRD occurs after the age of 50.[8]

In addition to aesthetic concerns, dermatochalasis can impair peripheral visual field function, leading to decreased vision due to mechanical blockage from excess skin, a sensation of heavy eyelids, and functional impairments.[1,3,5,6,9] Furthermore, eyelash ptosis, chronic blepharitis, skin erosion, and dry eye can be exacerbated by dermatochalasis.[1]

In elderly patients, accurate intraocular lens (IOL) power calculation is crucial due to the increasing demand for advanced lens options. However, changes in corneal curvature induced by dermatochalasis or blepharoplasty surgery can affect the accuracy of IOL power calculations, particularly in the presence of astigmatism.[10-14]

This study aims to assess how different IOL power calculation formulas are influenced by blepharoplasty surgery in patients with visual field defects due to dermatochalasis.

MATERIAL AND METHODS

This prospective study was conducted at the ophthalmology clinic of state hospital. Ethical approval was obtained, and informed consent was signed by all participants in accordance with the Declaration of Helsinki.

PATIENTS AND METHOD

A total of 166 eyes from 166 patients with superior visual field narrowing due to dermatochalasis were included (Figure 1). Only the right eyes of patients were included to the study. All patients underwent a comprehensive eye examination, which included best-corrected visual acuity, intraocular pressure (IOP) measurement (Goldmann applanation tonometry), anterior segment and fundus examinationvia slit-lamp biomicroscopy, MRD measurement, visual field testing (Humprey perimetry), and optical biometry.

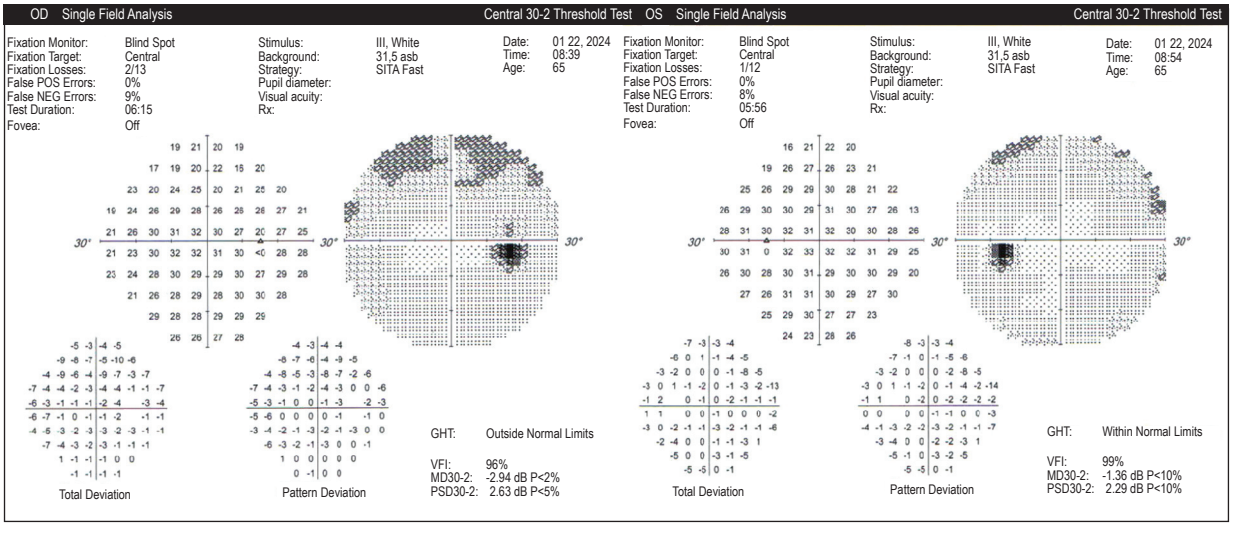

FIGURE 1: Narrowed visual field in the upper side of perimetry

MRD was defined as the distance between upper eyelid margin and the pupillary light reflex.

The study focused on evaluating the effect of upper eyelid blepharoplasty on corneal keratometry (average, steepest, flattest, corneal astigmatism), axial length (AL), and IOL power calculations using four different formulas [Sanders-Retzlaff-Kraff-Theoretical (SRK-T), Hoffer, Holladay, Haigis]. Measurements were taken at 3 time points: baseline, 10-12 days post-surgery, and 1 monthpost-surgery, using Nidek optical biometry (AL-Scan; Nidek Co., Ltd., Japan). Patients with a history of ocular surgery, contact lens wear, chronic ocular disease, media opacities, advanced cataracts, brow ptosis, or those unable to undergo measurements were excluded.

SURGICAL PROCEDURE

Excess skin was marked between 2 lines: one extending from the supratarsal fold tothe lateral canthus, and the other 1 cm below the eyebrow. Local anesthesia was administered using a combination of lidocaine and epinephrine. Skin excision was performed using a lancet and scissors, with additional excision of adipose tissue in cases of prolapse. Hemostasis was achieved using cautery, and sutures were placed using 6-0 polyglactin (MITSU, India) for connective tissue and 6-0 polipropilen (Neoplene Ultra, Turkey) for skin. Postoperative care included antibiotic ointment and cold compresses, and sutures were removed after 10 to 12 days.

STATISTICAL ANALYSIS

Data were analyzed using SPSS software (version 21.0, IBM Corp., Armonk, NY, USA). Normality of the data was assessed using the Shapiro-Wilk test. Continuous variables were presented as mean±standard deviation. Optical biometry measurements (keratometry, corneal astigmatism, central corneal thickness, AL and anterior chamber depth (ACD)) were analyzed using repeated measures analysis of variance (ANOVA) and Friedman tests. A p value of less than 0.05 was considered statistically significant. Astigmatism types were compared between visits using the McNemar test.

RESULTS

A total of 166 eyes from 166 patients were included in the study. Of the participants, 85.5% were female and 14.5% were male. The mean age of females was 56.80±9.73 years (range 37-78), and the mean age of males was 55.91±7.95 years (range 44-68). The optical biometry measurements (including AL, ACD), central corneal thickness (CCT), flattest, steepest and average corneal keratometry, corneal astigmatism) showed no significant differences between baseline and postoperative measurements ($p>0.05$). However, significant differences were found in the IOL power calculations using all formulas (SRK-T, Hoffer, Holladay, and Haigis) before and after surgery ($p<0.000$). (Table 1a, Table 1b, Table 2)

TABLE 1a: The optical biometric results of patients at baseline, 10-12 days and one month after surgery

	$\bar{X}$±SD/Median*			
Measurements	**Baseline visit**	**10-12 days after surgery**	**1 month after surgery**	**p value**
AL	23.13±0.82	23.12±0.84	23.13±0.83	0.28
ACD	3.09	3.10	3.07	0.29*
K_2.4mm_R1	43.08±1.62	43.07±1.65	43.07±1.61	0.96
K_2.4mm_R2	43.91±1.57	43.91±1.57	43.87±1.60	0.36
K_2.4mm_avr	43.50±1.61	43.50±1.58	43.47±1.56	0.53
Corneal astigmatism_2.4mm	-0.74	-0.73	-0.77	0.26*
K_3.3mm_R1	43.06±1.61	43.06±1.59	43.04±1.58	0.37
K_3.3mm_R2	43.86±1.58	43.87±1.60	43.87±1.55	0.58
K_3.3mm_avr	43.46±1.55	43.46±1.57	43.43±1.59	0.41
Corneal astigmatism_3.3mm	-0.67	-0.68	-0.68	0.20*

*: Friedman test; SD: Standard deviation; AL: Axial lenght; ACD: Anterior chamber depth; K_2.4 mm: Keratometry from 2.4 mm of the central cornea; K_3.3 mm: Keratometry from 3.3 mm of the central cornea; R1: Flattest meridian; R2: Steepest meridian; avr: average

TABLE 1b: The IOL power calculation results of patients at baseline. 10-12 days and one month after surgery

Measurements	X̄±SD/Median*			p value
	Baseline visit	10-12 days after surgery	1 month after surgery	
SRK_T formule	22.00	22.00	22.50	**0.000***
SRK_T formule residual refraction	0.00	-0.01	-0.01	0.28*
Hoffer formule	22.38±2.02	22.48±2.13	22.75±2.01	**0.000**
Hoffer formule residual refraction	0.01	0.02	-0.01	0.14*
Holladay formule	22.12±1.73	22.30±1.87	22.42±1.90	**0.000**
Holladay formule residual refraction	-0.00	-0.02	0.00	0.80*
Haigis formule	22.31±1.79	22.43±1.91	22.66±1.90	**0.000**
Haigis formule residual refraction	0.00	-0.01	-0.02	0.77*

*: Friedman test; SD: Standard deviation; IOL: Intraocular lens; SRK_T: Sanders-Retzlaff-Kraff-Theoretical

TABLE 2: The frequency of the type of astigmatism which is taken from 2.4mm and 3.3 mm of the cornea

Frequency of astigmatism (%)	Baseline	2nd visit	3rd visit	p value*
Axis_2.4				
With the rule	48.7	45.6	41	1.0
Against the rule	13.6	14.9	18.2	1.0
Oblique	37.7	39.5	40.8	
Axis_3.3				
With the rule	52.8	49	43.8	1.0
Against the rule	14.7	13.4	18.7	1.0
Oblique	32.5	37.6	37.5	

*Mc Nemar test

DISCUSSION

The primary goal of upper eyelid blepharoplasty is to remove excess skin and adipose tissue while addressing mild ptosis. This procedure has both functional and cosmetic improvements for patients with dermatochalasis.

In this procedure, the wound healing of sutured skin reaches the proliferative phase approximately 4 weeks after surgery.[15] During this time, healing is primarily facilitated through epithelization, with limited production of extracellular matrix components in the dermis.[16] After this initial 4-week period, surgery-related factors that could influence ocular measurements diminish. Therefore, it is crucial to obtain postoperative measurements at the 4th week to accurately assess the effects of blepharoplasty on ocular parameters.

Several studies have examined the effect of blepharoplasty on visual acuity, with mixed results. In some cases, blepharoplasty has been shown to improve visual acuity, particularly by enhancing contrast sensitivity, reducing high-order aberrations, and expanding the visual field.[3,9,17-23] This improvement is though to be due to the reduction in mechanical obstruction of the visual field and the correction of eyelid ptosis, which may lead to better visual perception. On the other hand, other studies have reported no significant change in visual acuity, or even a decline, potentially attributable to changes in corneal refraction, such as increased astigmatism or alterations in the keratometric readings.[10,11,13,21,24,25]

The impact of blepharoplasty on corneal measurements has been documented in several studies.[2,3,9-13,17,19,20] Most studies report significant refractive changes, particularly in corneal curvature and astigmatism, postoperatively.[10,11,17,26,27] These changes are typically associated with the mechanical effect of excess skin and adipose tissue on the ocular surface. The extent of these refractive changes is inversely related to the MRD; the greater the preoperative MRD, the less substantial the postoperative changes in corneal measurements are likely to be.[10,11,20,28]

Interestingly, studies also indicate that certain ocular parameters, such as ACD, CCT, and AL, are generally unaffected by blepharoplasty.[11,17,29,30] These parameters tend to remain stable, as they are less likely to be influenced by the changes in eyelid posi-

tioning that occur during surgery. However, some studies have observed an increase in IOP following blepharoplasty, which may be attributed to the tightening of the upper eyelid and the resulting alteration in the dynamics of the anterior chamber.[28,31] İnal Özen et al. investigated the effects of blepharoplasty on corneal biomechanics and reported a significant decrease in corneal hysteresis postoperatively.[32]

Despite the fact that the literature includes studies examining the effects of blepharoplasty on corneal topography, only a limited number have focused specifically on the relationship between blepharoplasty and IOL power calculation. For example, Vola et al. reported that after blepharoplasty, the average corneal curvature, steepest corneal curvature, and corneal astigmatism increased, resulting in a decrease in IOL power when measured with the IOL Master. However, no significant changes in IOL power were noted when the Gallilei system was used for measurement.[30]

The present study, in contrast, observed statistically insignificant decrease in corneal keratometry, including average corneal curvature, steepest meridian, or corneal astigmatism, postoperatively. This suggests that, in our cohort, blepharoplasty did not significantly affect the corneal shape or astigmatism directly. However, we did observe significant changes in the IOL power calculations across all formulas (SRK-T, Hoffer Q, Haigis, and Holladay), with power estimates increasing significantly after surgery. This result may be attributed to these insignificant changes in corneal parameters. However, this finding contrasts with previous studies, such as the one by Vola et al., which reported a decrease in IOL power postoperatively.[30]

The difference between our findings and those of Vola et al. could be attributed to several factors. First, our study included a larger sample size, which may provide a more accurate representation of the population. Additionally, we employed four different IOL power calculation formulas, offering a broader perspective on the potential impact of blepharoplasty on IOL power calculations. The use of multiple formulas is essential, as each formula incorporates different ocular parameters and assumptions, which may lead to varying results.

Despite the absence of significant changes in corneal parameters, the observed increase in IOL power calculations after surgery suggests that factors beyond corneal curvature may influence IOL power estimates. One potential explanation could be related to changes in the eyelid position and its subsequent effect on the eye's mechanical properties, which might alter the effective lens position used in IOL power formulas. Another consideration is that postoperative changes in the lid position could affect the measurement of the AL or ACD, both of which play a critical role in IOL power calculations. Although we did not observe significant changes in these parameters, subtle shifts may still contribute to alterations in the final IOL power estimate.

It is important to note that accurate IOL power calculation is critical for achieving optimal postoperative visual outcomes, particularly with the increasing demand for premium lenses such as multifocal or toric IOLs. Even small variations in IOL power can have a significant impact on visual acuity, especially in patients with higher refractive expectations. As such, preoperative evaluation of IOL power should take into account the potential effects of blepharoplasty surgery, particularly in patients undergoing cataract surgery or the implantation of premium IOLs.

CONCLUSION

IOL power calculations are highly sensitive, and although corneal keratometric measurements may not show significant differences following blepharoplasty, these subtle changes can still affect the accuracy of the power calculations. Given the critical importance of precise IOL calculations for achieving optimal postoperative visual acuity, it is recommended that blepharoplasty be performed prior to the implantation of premium lenses, particularly in older populations. This approach ensures the stability of corneal measurements and enhances the accuracy of IOL power assessments, ultimately contributing to better visual outcomes. To the best of our knowledge, only one study in the literature has previously investigated the relationship between IOL formulas and blepharoplasty, using a small sample size and the Holladay formula exclusively.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

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