Original Article

Intraocular Lens Power Calculation among Patients with a History of Keratorefractive Surgery: Comparison of Historical and Non-Historical Methods

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Abstract

Purpose: To compare the accuracy of historical and non-historical methods in intraocular lens (IOL) power calculation among patients undergoing cataract surgery with a history of keratorefractive surgery.

Patients and Methods: In this cross-sectional study, patients undergoing cataract surgery were divided into two groups: the first group consisted of patients with available previous data regarding their history of keratorefractive surgery, and the second group included patients without any previous data. Corneal power was corrected using the clinical history method (CHM) in the first group and the Shammas no history method (SNHM) in the second group. IOL power for both groups was calculated using the Holladay I formula for implanting an SA60AT or SN60WF lenses. The main outcome measure was the mean refractive error three months after cataract surgery.

Results: One hundred twenty-nine eyes from 104 cataract patients with a history of myopic keratorefractive surgery were included in this study. The IOL calculation in 64 eyes was performed using the CHM method, and in 65 eyes using the SNHM method. The mean refractive error after cataract surgery was -0.17 ± 1.09 D in the CHM group and -0.09 ± 0.75 D in the SNHM group, indicating no statistically significant difference between the two methods (P = 0.62).

Conclusions: The SNHM showed no significant difference compared to the CHM in terms of post-surgical mean refractive error. Given the ease of performing the SNHM and the similarity in post-surgical refractive outcomes, it is suggested that the SNHM can serve as an alternative to the CHM.

Keywords: Cataract; Historical; Non Historical; Corneal Surgery; Intra Ocular Lens Power; Keratorefractive Surgery.

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Introduction

The importance of calculating intraocular lens (IOL) power in patients undergoing cataract surgery has increased with the advent of modern IOLs. Furthermore, the accuracy of IOL power calculation significantly influences patient satisfaction following cataract surgery. Despite innovations in IOL power calculation methods, accurately achieving the desired outcomes remains a significant challenge for patients with a history of previous keratorefractive surgery [1]. This challenge arises from the various structural changes to the cornea caused by previous refractive surgery [2]. On the other hand, patients who have undergone refractive surgeries like laser in situ keratomileusis (LASIK) typically have high expectations for cataract surgery, fueled by their satisfaction with the results of their previous surgery [3]. Thus, correctly calculating and predicting IOL power in these patients is a current challenge for eye surgeons.

Solutions to this problem include methods such as using the patient's clinical history from their previous keratorefractive surgery or the clinical history method (CHM), contact lens over-refraction method, refractive-derived method, and the Shammas no-history method (SNHM) [4-7]. Some of these methods rely on historical data, while others do not. This distinction is crucial due to the common occurrence of IOL power underestimation and unintended hyperopic outcomes after surgery [3,8-10].

Recently, several methods have been introduced to enhance the accuracy of corneal power measurement among these patients, with some directly calculating the IOL power [11-16]. Techniques like the use of the Scheimpflug camera for evaluating the cornea's anterior and posterior surfaces are acceptable in some cases and offer high precision. However, the widespread testing of these methods across various populations is limited by high costs and the scarcity of devices in specific clinics [17]. Although methods exist for calculating IOL power without needing the patient's previous history, none is completely accurate, and some patients still experience significant post-surgical refractive errors. Given these challenges and limitations, we aimed to compare two methods for IOL power calculation in these patients: one requiring past patient history and the other relying solely on current measurements.

Patients and Methods

In this study, 129 eyes from 104 cataract patients who had previously undergone myopic keratorefractive surgery were enrolled. All patients were from Basir Eye Clinic, Tehran, Iran, and entered the study from May 2015 to September 2016. The study was approved by the local ethics committee, and informed consent was obtained from all patients before their participation.

The inclusion criteria were the need for cataract surgery and a history of myopic keratorefractive surgery. The exclusion criteria included any eye disease other than cataract, such as diabetic retinopathy and glaucoma, the need for any other surgical intervention like trabeculectomy or vitrectomy, and any surgical complications like posterior capsule tear, as well as the implantation of an Artisan aphakia lens. In all patients, manual keratometry was performed using the Haag-Streit Javal keratometer (Javal-Schiutz-HS-Bern-Switzerland). Additionally, ultrasonic axial length was measured using the immersion method with the NIDEK biometry machine (Echoscan, model U3300; Nidek, Tokyo, Japan).

Patients were divided into two groups. The first group, known as the CHM group, included 64 eyes from patients who had a complete record available from their previous keratorefractive surgery. For these patients, corneal power was modified using the patient's previous clinical history. The second group included 65 eyes from patients with no available information from their previous keratorefractive surgery. The corneal power of these patients was modified for the calculation of intraocular lens power using the SNHM. This formula is a regression formula devised to correct corneal power and does not require any previous data from the patients' history of refractive surgery. After calculating the corneal power in both groups using CHM for the first group and SNHM for the second group, the Holladay I formula was employed to calculate the IOL power for all patients in both groups, and either Alcon SA60AT or SN60WF lenses were implanted by one surgeon. All patients were examined the day after surgery and re-examined 3 days, 7 days, and one month post-surgery. Furthermore, optometry examinations for all patients in both groups were performed and recorded one and three months after the surgery using an auto-refractometer (TOPCON Automatic Refractor model KR-8800, Tokyo, Japan) by a trained and skilled optometrist. The refractive errors, considered the outcome criteria after 3 months, were calculated using the spherical equivalent (SE).

Results

In the present study, 129 eyes from 104 patients were divided into two groups: 64 eyes (49.16 %) in the CHM group and 65 eyes (50.84 %) in the SNHM group. Gender distribution showed no statistically significant difference between the two groups (Table 1). The mean age of the study population was 52.11 ± 5.97 years. The shortest axial length measured in this study was 23.25 mm, and the longest was 33.46 mm, with an average axial length of 27.11 mm ± 2.22 mm (Table 1). Additional demographic data are presented in table 1.

Three months after cataract surgery, the mean refractive error in the CHM group was calculated to be -0.17 ± 1.09 D, while in the SNHM group, it was -0.09 ± 0.75 D. Based on the Paired T-test, the difference between the two groups was not statistically significant (P = 0.62). Table 2 presents the mean refractive error in both groups.

Discussion

Although the published literature suggests that the CHM formulation is a proper method to modify corneal power and calculate intraocular lens (IOL) power after refractive surgery, high refractive errors can still be observed following its use for corneal power correction after cataract surgery [18-20].

Our results indicated that the SNHM showed no significant difference compared to the CHM regarding the mean refractive error three months after cataract surgery (P=0.62). In a study carried out by McCarthy et al., [21] five combinations of different methods and formulas were compared in calculating IOL power among patients undergoing cataract surgery with a history of keratorefractive surgery. One of these methods was the CHM, resulting in an average postoperative error of -0.27 ± 1.04 diopters. In this study, the SNHM was also evaluated resulting in an average postoperative error of -0.10 ± 1.02 diopters. These results are in line with our findings.

In a study by Feiz et al., [20] the CHM method was found to be less accurate than the nomogram-

Table1: Demographic data in two groups of patients entering the study

Variable		Group			
CHM*		SNHM	Total	P value	
Age		51.53 (41to 68)	52.69 (32 to 66)	52.11(32 to 68)	0.27
Sex		Male: 30 (46.9 %) Female: 34 (53.1 %)	Male: 32 (49.2 %) Female: 33 (50.8 %)	Male: 62 (48.1 %) Female: 67 (51.9 %)	0.78
Axial Length		27.04 (23.25 to 32.65)	27.18 (23.33 to 33.46)	27.11(23.25 to 33.46)	0.72
Visual Acuity	BCVA (LogMAR)	0.09 ± 0.11	0.09 ± 0.07	-	0.879
	BCVA (Decimal)	0.81 ± 1.1 line	0.81 ± 0.7 line		
	UCVA (LogMAR}	0.202 ± 0.25	0.16 ± 0.17		0.144
	UCVA (Decimal)	0.62 ± 2.5 line	0.68 ± 1.7 line		
MRSE (D)					
	Before Keratorefractive Surgery				
	Mean ± SD	-8.09 ± 4.78	NA	NA	
	Range	-1.5 to -19.5	NA	NA	
Corneal Power					
	Before Keratorefractive Surgery				
	Mean ±SD	43.97 ± 1.67	NA	NA	
	Range	40.59 to 47.76	NA	NA	
Corrected-Corneal Power					
	Mean ± SD	37.1 ± 4.07	37.27 ± 3.00	37.28 ± 3.23	
	Range	27.22 to 44.77	30.53 ± 42.79	26.83 ± 44.5	

CHM: Clinical History Method
SNHM: Shammas No History Method
BCVA: Best Corrected Visual Acuity
UCVA: Uncorrected Visual Acuity
MRSE: Manifest Refraction Spherical Equivalent

based method, with error within ±0.5 diopter range in only 37.5 % of patients. In contrast, a study by Savini et al., [22] indicated that for a group of patients with unknown preoperative keratometry and refractive changes, the SNHM had a low median absolute error (0.31 D), with 83 % of eyes within ± 0.50 D of the predicted refraction. The authors suggested that IOL power can be accurately calculated

Table 2: Comparison between the mean refractive errors of two groups of patients after cataract surgery

Group	Count	Mean ± SD	P value
CHM	64	0.17 ± 1.09 -	0.62
SNHM	65	0.09 ± 0.75 -	

CHM: Clinical History Method
SNHM: Shammas No History Method

in post-laser surgery eyes, both when the preoperative corneal power and refractive change are known and when they are not, with comparable error results, aligning with our findings. Another study by Shammas et al., [23] on 15 cataractous eyes with previous myopic laser in situ keratomileusis (LASIK) and no available pre-LASIK K-readings, found the mean absolute IOL prediction error to be 0.55 ± 0.31 D (range -0.89 to +1.05 D), with fourteen eyes (93.3 %) within ±1.00 D. The authors concluded that the SNHM is a viable alternative for IOL power calculation after myopic LASIK when refractive surgery data are not available. Chan et al., [24] retrospectively reviewed 34 eyes that underwent routine phacoemulsification and IOL implantation after photorefractive keratectomy or LASIK, including sixteen eyes in the final analysis. They found that the CHM at the spectacle plane produced the lowest mean K-values, and SNHM combined with Holladay 2 and Hoffer Q produced results closest to emmetropia, suggesting that SNHM is a particularly viable alternative in the absence of preoperative data. Given that the CHM method is considered the gold standard by some surgeons and requires previous patient history, we expected much better results for CHM. Nonetheless, despite using detailed patient histories in the CHM method, we achieved comparable results with SNHM. This may be attributed to not using the same device for measuring corneal refractive power as was used before the primary surgery, performed years ago. Current devices are more advanced, potentially disadvantaging the CHM method since their readings may not align with those from older devices.

In a review article comparing history and no-history formulas, De Bernardo et al., [25] suggested that methods requiring knowledge of medical history are difficult to use since, in many patients, the preoperative keratometry values and the exact refractive treatment details are not available. Additionally, a recent meta-analysis by Chen et al., [26] compared history and no-history methods in IOL power calculation after laser refractive surgery in myopic eyes, concluding that the SNHM had good prediction accuracy, while the CHM, Feiz-Mannis method, and corneal bypass method, which require historical data, were less accurate in their predictions.

Due to the importance of accurate IOL power calculation and its impact on patient satisfaction, finding a method that is less error-prone and more economical is desirable. Our findings suggest that the SNHM is as accurate as the CHM. Further studies with larger sample sizes are recommended to confirm this finding.

Conclusions

The SNHM showed no significant difference compared to the CHM in terms of post-surgical mean refractive error. Given the ease of performing the SNHM and the similarity in post-surgical refractive outcomes, it is suggested that the SNHM can serve as an alternative to the CHM. Further research with larger sample sizes is recommended to validate this finding.

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Footnotes and Financial Disclosures

Conflict of Interest:

The authors have no conflict of interest with the subject matter of the present study.