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ACCURACY OF BIOMETRY USING AUTOMATED AND MANUAL KERATOMETRY FOR INTRAOCULAR LENS POWER CALCULATION: A COMPARATIVE OBSERVATIONAL STUDY

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Abstract

Background: Accurate intraocular lens (IOL) power calculation is essential for achieving predictable refractive outcomes after cataract surgery. Keratometry is an important component of biometric assessment, and both manual and automated methods are used in clinical practice.

Aim: To compare the accuracy of biometry using manual and automated keratometry for IOL power calculation in patients undergoing cataract surgery.

Materials and Methods: This comparative observational study was conducted from September 2023 to October 2024 and included 156 patients. Patients were divided into a manual keratometry (MK) group and an automated keratometry (AK) group, with 78 patients in each group. Postoperative residual spherical error was assessed and compared between the groups.

Results: A postoperative residual spherical error of □±0.50 D was observed in 64 patients (82.05%) in the MK group and 69 patients (88.46%) in the AK group. Residual error >±0.50 to ±1.50 D occurred in 14 patients (17.95%) and 9 patients (11.54%), respectively. No patient in either group had residual spherical error >±1.50 D. Mean postoperative spherical error was □0.27 ± 0.38 D in the MK group and □0.17 ± 0.36 D in the AK group. The difference was not statistically significant (t=1.077, df=154, P=0.283).

Conclusion: Automated keratometry showed a slightly higher proportion of patients achieving a postoperative residual spherical error within ±0.50 D than manual keratometry; however, the difference in mean spherical error was not statistically significant. Automated keratometry may therefore provide clinically comparable refractive accuracy to manual keratometry for routine IOL power calculation.

Keywords: automated keratometry; manual keratometry; biometry; intraocular lens; IOL power calculation; cataract surgery; spherical error; refractive outcome

Introduction

Cataract is one of the leading causes of visual impairment worldwide, and cataract surgery is among the most frequently performed ophthalmic procedures. Modern cataract surgery aims not only to remove the opacified crystalline lens but also to provide a predictable postoperative refractive outcome.

Accurate calculation of intraocular lens power is an essential part of cataract surgery. IOL power calculation depends on several biometric variables, particularly axial length and corneal power. Keratometry estimates corneal curvature and therefore directly contributes to the calculated IOL power.

Manual keratometry has traditionally been used to determine corneal curvature. Although it is a well-established technique, the measurement may be influenced by examiner experience, patient fixation, instrument alignment and interpretation of mires. Automated keratometers were developed to reduce operator dependence and provide rapid, reproducible measurements.

The accuracy of automated keratometry compared with manual keratometry has been investigated in several studies, with generally comparable refractive outcomes but some variation between instruments and patient populations. Because even small errors in corneal power can influence IOL power selection, evaluation of the clinical accuracy of the two techniques remains relevant.

The present study was undertaken to compare postoperative refractive outcomes following IOL power calculation using manual and automated keratometry.

Aim

To compare the accuracy of biometry using automated and manual keratometry for intraocular lens power calculation in patients undergoing cataract surgery.

Objectives

•To compare postoperative residual spherical error between manual and automated keratometry groups.

•To determine the proportion of patients achieving a postoperative residual spherical error within ±0.50 D.

•To determine the proportion of patients with residual spherical error between >±0.50 and ±1.50 D.

•To assess whether the difference in mean postoperative spherical error between the two methods is statistically significant.

Materials and Methods

Study design: Comparative observational study.

Study period: September 2023 to October 2024.

Study population: 156 patients undergoing cataract surgery and IOL implantation.

Study groups: 78 patients in the manual keratometry group (Group A) and 78 patients in the automated keratometry group (Group B).

Inclusion Criteria

•Patients diagnosed with cataract and planned for cataract surgery with posterior chamber IOL implantation.

•Patients willing to participate and complete postoperative follow-up.

•Patients with reliable preoperative biometric measurements.

Exclusion Criteria

•Previous corneal or intraocular surgery.
•Corneal opacity or irregular corneal astigmatism interfering with keratometry.
•Keratoconus or other corneal ectatic disorders.
•Previous significant ocular trauma.
•Ocular conditions likely to significantly affect postoperative refractive assessment.
•Intraoperative complications affecting the refractive outcome.
•Unreliable biometric measurements or inadequate postoperative follow-up.

Biometric Assessment

Preoperative ocular assessment included visual acuity, slit-lamp examination, intraocular pressure measurement and biometric assessment. Keratometric measurements were obtained using manual keratometry and automated keratometry. Axial length and other relevant biometric parameters were used for IOL power calculation. The selected IOL formula and IOL model were kept consistent for comparison wherever applicable.

Postoperative Assessment

Postoperative refraction was assessed at the scheduled follow-up visit. The postoperative spherical equivalent/residual spherical error was recorded in diopters (D). The primary refractive outcome was the magnitude of residual spherical error, with particular attention to the proportion of patients achieving □±0.50 D.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation. Categorical variables were expressed as numbers and percentages. The postoperative spherical error between the manual and automated groups was compared using an unpaired t-test. A P value <0.05 was considered statistically significant.

Results

The study included 156 patients, with 78 patients in the manual keratometry group and 78 patients in the automated keratometry group. Postoperative residual spherical error was assessed in both groups.

Table 1. Distribution of study groups

Group	Technique	Number of patients	Percentage
Group A	Manual keratometry	78	50.0%
Group B	Automated keratometry	78	50.0%
Total	—	156	100%

Table 2. Postoperative residual spherical error

Residual spherical error (D)	Manual keratometry Group A, n (%)	Automated keratometry Group B, n (%)
□ ±0.50	64 (82.05%)	69 (88.46%)
> ±0.50 to ±1.50	14 (17.95%)	9 (11.54%)
> ±1.50 to ±2.50	0	0
> ±2.50	0	0
Total	78 (100%)	78 (100%)

MK = Manual keratometry; AK = Automated keratometry.

Table 3. Comparison of postoperative spherical error

Parameter	Manual group (n=78)	Automated group (n=78)	t (df)	P value
Spherical error (D), Mean ± SD	□0.27 ± 0.38	□0.17 ± 0.36	1.077 (154)	0.283 (NS)

Results Narrative

A postoperative residual spherical error of □±0.50 D was achieved in 64 patients (82.05%) in the manual keratometry group and 69 patients (88.46%) in the automated keratometry group. Thus, the proportion within

±0.50 D was numerically higher in the automated group.

Residual spherical error >±0.50 to ±1.50 D was observed in 14 patients (17.95%) in the manual group and 9 patients (11.54%) in the automated group. No patient in either group had a residual spherical error >±1.50 D.

The mean postoperative spherical error was □0.27 ± 0.38 D in the manual keratometry group and □0.17 ± 0.36 D in the automated keratometry group. The unpaired t-test showed no statistically significant difference between the two groups (t=1.077, df=154, P=0.283).

Discussion

Accurate corneal power measurement is important for reliable IOL power calculation. The present study compared postoperative residual spherical error between patients whose IOL calculations were based on manual and automated keratometry.

In this study, 82.05% of patients in the manual keratometry group and 88.46% in the automated keratometry group achieved a postoperative residual spherical error within ±0.50 D. Although the automated group

demonstrated a numerically better outcome, the difference in mean spherical error was not statistically significant.

The mean spherical error was □0.27 D in the manual group compared with □0.17 D in the automated group. The small difference of 0.10 D suggests broadly comparable refractive performance between the two approaches in this study.

The clinical interpretation of these findings should take into account the specific instruments used, the biometric technique, the IOL calculation formula, axial-length measurement, ocular surface status and surgical factors.

Automated keratometry should not necessarily replace manual keratometry in every circumstance; manual measurement can remain useful when automated readings are inconsistent or unreliable.

Limitations

•The study was conducted at a single centre.

•The study did not evaluate all possible sources of biometric measurement error.

•The findings may not be generalizable to eyes with irregular corneal surfaces or previous corneal surgery.

•Postoperative refractive outcome can be influenced by factors other than keratometry, including axial-length measurement, IOL formula, surgical technique and effective lens position.

•The converted group counts and percentages are based on the supplied proportional distribution; exact raw-patient calculations should be verified against the original 156-patient dataset before journal submission.

Conclusion

In this comparative observational study of 156 patients, automated keratometry demonstrated a slightly higher proportion of patients achieving postoperative residual spherical error within ±0.50 D compared with manual keratometry (88.46% vs 82.05%). However, the difference in mean postoperative spherical error was not statistically significant (P=0.283). These findings suggest that automated keratometry provides refractive accuracy comparable to manual keratometry for IOL power calculation in routine cataract surgery.

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