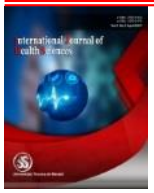

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To Evaluate the Effects of Lubricating Eye Drops on the Repeatability of Keratometry (K) Measurements in Patients Presenting for Cataract Surgery

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Keywords

artificial tears;
lubricating eye drops;
cataract surgery;
dry eye;
Keratometry;

Abstract

Purpose: To evaluate the effects of lubricating eye drops on the repeatability of keratometry (K) measurements in patients presenting for cataract surgery. Design: Prospective, Comparative, Hospital-based study. Method: K readings were taken using the automatic keratometer of an autorefractometer. At Study Visit 1, keratometry was performed twice consecutively before instilling any eye drops. After instilling artificial tears, K readings were taken at 30 seconds and 2 minutes. Tear Break-Up Time (TBUT) was measured, and patients were divided into two groups [normal and dry eye]. The next morning, a second set of readings was taken. At Study Visit 2, one week post-surgery, a third set of K1 and K2 readings was recorded. Result: This study investigates variations in keratometry readings (K1 and K2) across different time points and between normal and dry eye patients. At Study Visit 1, keratometry was measured before and after the instillation of artificial tears, with readings taken at multiple intervals. Post-hoc analysis reveals significant differences in the mean K1 values between various time points within the dry eye group, with p-values consistently below 0.0001. Additionally, significant differences were found between normal and dry eyes at 0.5 minutes and 2 minutes post-instillation. For K2, significant differences were noted within the normal eyes group between pre-op and post-op time points, and the dry eye group across all measured intervals, with p-values indicating high statistical significance. Conclusion: Using tear film-stabilizing eye drops before keratometry measurements can significantly affect K-readings, particularly in dry-eyed individuals. Waiting for more than 5 minutes after instilling the eye drops before taking measurements is recommended.

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Contents

1 Introduction

Cataract surgery has increasingly become a refractive procedure rather than merely a rehabilitative one. Accurate intraocular lens (IOL) power calculations are essential to ensure good uncorrected vision post-surgery. This is particularly important when patients opt for advanced-technology IOLs, as an accurate refractive outcome is crucial for patient satisfaction. A key component of all IOL power calculation formulas is the anterior corneal curvature, measured by keratometry. The average corneal curvature helps determine the appropriate sphere power, while the measured anterior corneal astigmatism aids in planning for a toric IOL.

Manual keratometry is reliable and precise in normal eyes. However, unreliable K readings can affect the accuracy of IOL calculations, leading to suboptimal refractive outcomes after cataract surgery. A 1.0 diopter (D) error in the measured corneal power can result in approximately a 1.0 D error in postoperative refraction. Dry eye is a multifactorial disease affecting the tears and ocular surface, characterized by increased tear film osmolarity. It causes symptoms such as discomfort, visual disturbances, and tear film instability, which can potentially damage the ocular surface. Dry eye is one of the most common conditions encountered in ophthalmology practice. Previous studies have reported its prevalence to range between 3.9% and 16.7%, with higher rates observed in the elderly and women.

The tear film creates a smooth refracting surface for the cornea. Keratometric measurements are highly sensitive to the quality of the tear film, as standard keratometers rely on clear reflections of mires from the corneal surface. Additionally, dry eye disease becomes more common with age, making tear film instability a frequent issue among cataract surgery patients.

In a clinical setting, biometry often needs to be repeated multiple times due to an unstable tear film. Keratometry of dry eyes is known for its high variability in both short-term and long-term repeatability. Artificial tears are commonly used to improve the ocular surface for precise eye measurements. However, anecdotal reports suggest that using eye drops may alter these measurements.

Objectives – To compare the changes in keratometric readings of the cornea before and after the instillation of artificial tears in patients suffering from dry eye, in comparison to normal eyes undergoing cataract surgery.

2 Materials and Methods

A prospective, comparative, hospital-based study was conducted at KLES Dr. Prabhakar Kore Hospital and MRC, Belagavi, over a duration of 1 year from July 1, 2021, to June 30, 2022. A total of 80 patients aged above 50 years, admitted for cataract surgery at KLES Dr. Prabhakar Kore Hospital, Belagavi, were included. They were divided into two groups of 40 each: Group A (Dry Eye) and Group B (Normal Eyes). Dry eyes were confirmed using TBUT.

Inclusion criteria:

- Patients admitted to the hospital for cataract surgery

Exclusion criteria:

1. Any corneal pathologies
2. Use of any eye drops 24 hours before examination
3. Necessity of any topical eye therapy
4. Active ocular/nasal allergies
5. Corneal/conjunctival infection
6. Abnormality of NLD apparatus
7. Severe dry eye
8. Eyelid deformity
9. Previous ocular surgery or trauma

Methodology

All eligible patients meeting the inclusion and exclusion criteria were enrolled in the study after providing informed and written consent. A detailed clinical history was obtained.
Patients were divided into two groups:

- **Group A:** Dry eye individuals
- **Group B:** Normal individuals

Ocular examinations included:

- Visual acuity assessment
- Examination of eyelids, conjunctiva, lacrimal apparatus, cornea, anterior chamber, and fundus
- Tear film evaluation using TBUT (diagnosing dry eyes as TBUT <10 seconds or corneal staining consistent with punctate keratitis).

At **Study Visit 1**:

1. Keratometry was performed twice consecutively before instilling artificial tears.
2. Artificial tears were instilled, and K readings were taken at 30 seconds and 2 minutes.
3. TBUT was measured.
4. Next morning, the second set of readings was taken.

At **Study Visit 2** (1 week post-surgery):

- A third set of K1 and K2 readings was recorded.

Statistical Analysis

Data was analyzed using R software version 4.1.2 and Excel. Continuous variables are presented as Mean ± SD. Two-sample t-tests were used to compare means across groups. Mixed-effects models were used to analyze K1 and K2 measurements over time points. Post-hoc analysis was performed using pairwise t-tests with Bonferroni p-value adjustments. A p-value ≤ 0.05 indicated statistical significance.

3 Results and Discussions

3.1 Results

Data contains measurements on 80 subjects whose age ranges from 60-75 years, with a mean age of 66.95 ± 4.27 years. They are divided into 2 groups (normal eyes and dry eyes) of 40 subjects each. The following table gives a comparison of age across groups.

Table 1
Comparison of age across groups

Variable	Group		p-value
	Dry Eye	Normal Eye	
Age (in years)	67.1±4.17	66.8±4.47	0.8273[t]

Abbreviations: t: Two-sample t-test

From the two-sample t-test, we can clearly say that there is no significant difference in the mean age between the groups. The table below gives a comparison of K1 and K2 between the groups at the time point.

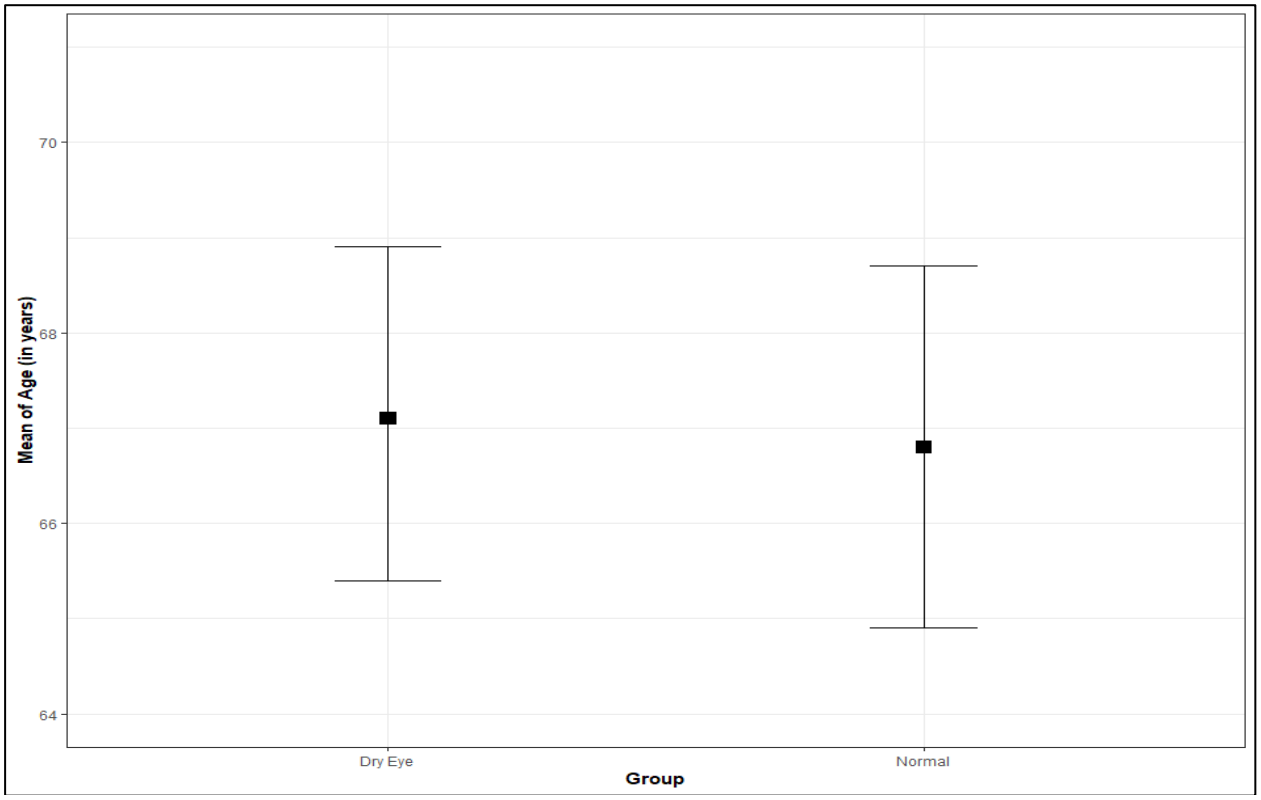

Figure 1. Comparison of age across groups

Table 2
Comparison of K1, K2 between groups and over time points

Variable	Time points	Group		p-value
		Normal Eye	Dry Eye	
K1	Pre-op	44.28±1.25	44.42±1.21	
	0 minutes	44.30±1.31	44.40±1.20	<0.0001*[T]
	0.5 minutes	44.54±1.31	47.44±0.97	<0.0001*[G]
	2 minutes	44.05±1.13	46.87±1.05	
K2	Pre-op	44.95±1.17	44.98±1.24	
	0 minutes	44.98±1.16	45.02±1.21	<0.0001*[T]
	0.5 minutes	44.75±1.17	47.67±1.12	<0.0001*[G]
	2 minutes	45.28±0.99	46.42±1.08	

Abbreviations: T: Time effect; G: Group effect

In the above table we can observe that, there is significant difference in the mean of K1 between different time points and groups from post-hoc analysis, it is observed that, within dry eye subjects, there is difference in the mean between pre-op-0.5 minutes (p-value: <0.0001), pre-op-2 minutes (p-value: <0.0001), 0 minutes -0.5 minutes (p-value: <0.0001), 0 minutes-2 minutes (p-value: <0.0001). Moreover, at 0.5 minute and 2 minutes, there is a difference in the mean of K1 between normal eyes and dry eyes (both p-values are <0.0001). In the above table we can observe that, there is significant difference in the mean of K2 between different time points and over groups from post-hoc analysis, it is observed that, within normal eyes group, there is difference in the mean between pre-op-2 minutes (p-value: 0.001), 0 minutes-2 minutes (p-value: 0.00076) and 0.5 minutes-2 minutes (p-value: 0.00079). Similarly, within dry eye subjects, there is difference in the mean between pre-op-0.5 minutes (p-value: <0.0001), pre-op-2 minutes (p-value: 0.00004), 0 minutes -0.5 minutes (p-value: <0.0001), 0 minutes-2 minutes (p-value: <0.00001), 0.5 minutes-2 minutes (p-value: 0.001). At 0.5 minute and 2 minutes, there is a difference in the mean of K1 between normal eyes and dry eyes (both p-values are <0.0001). The below plot summarizes the above table.

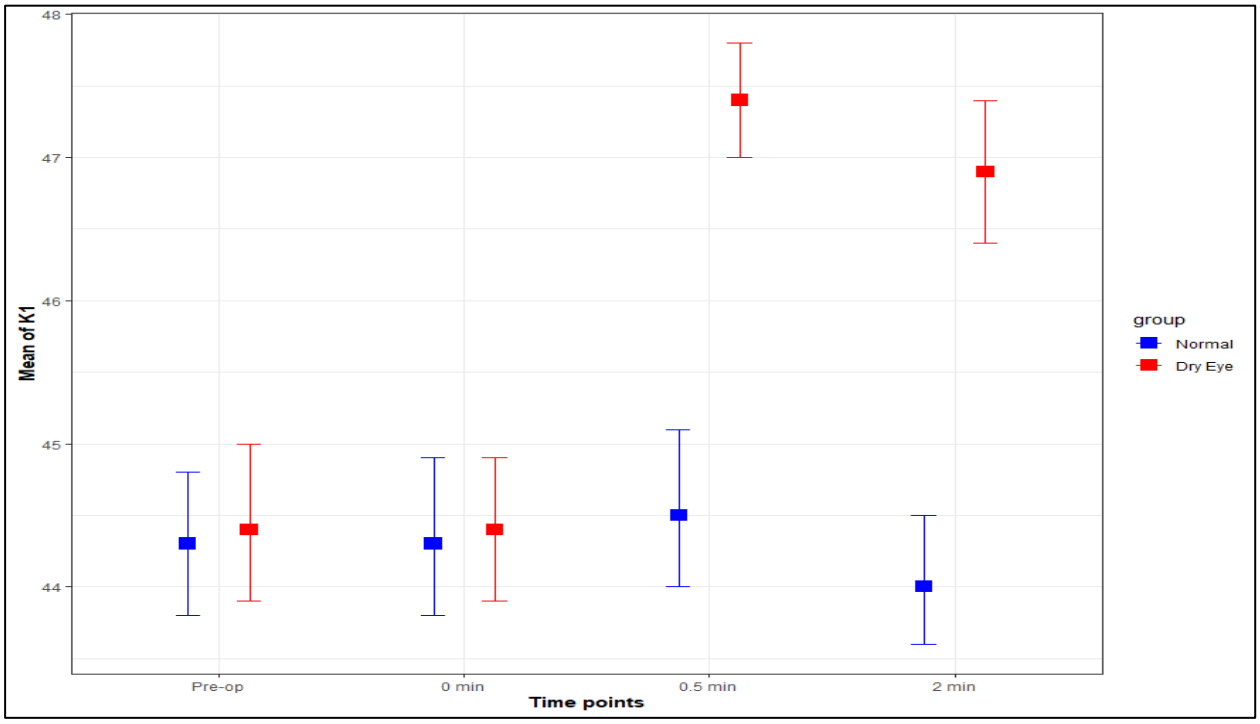

Figure 2. Comparison of K1 over time and groups

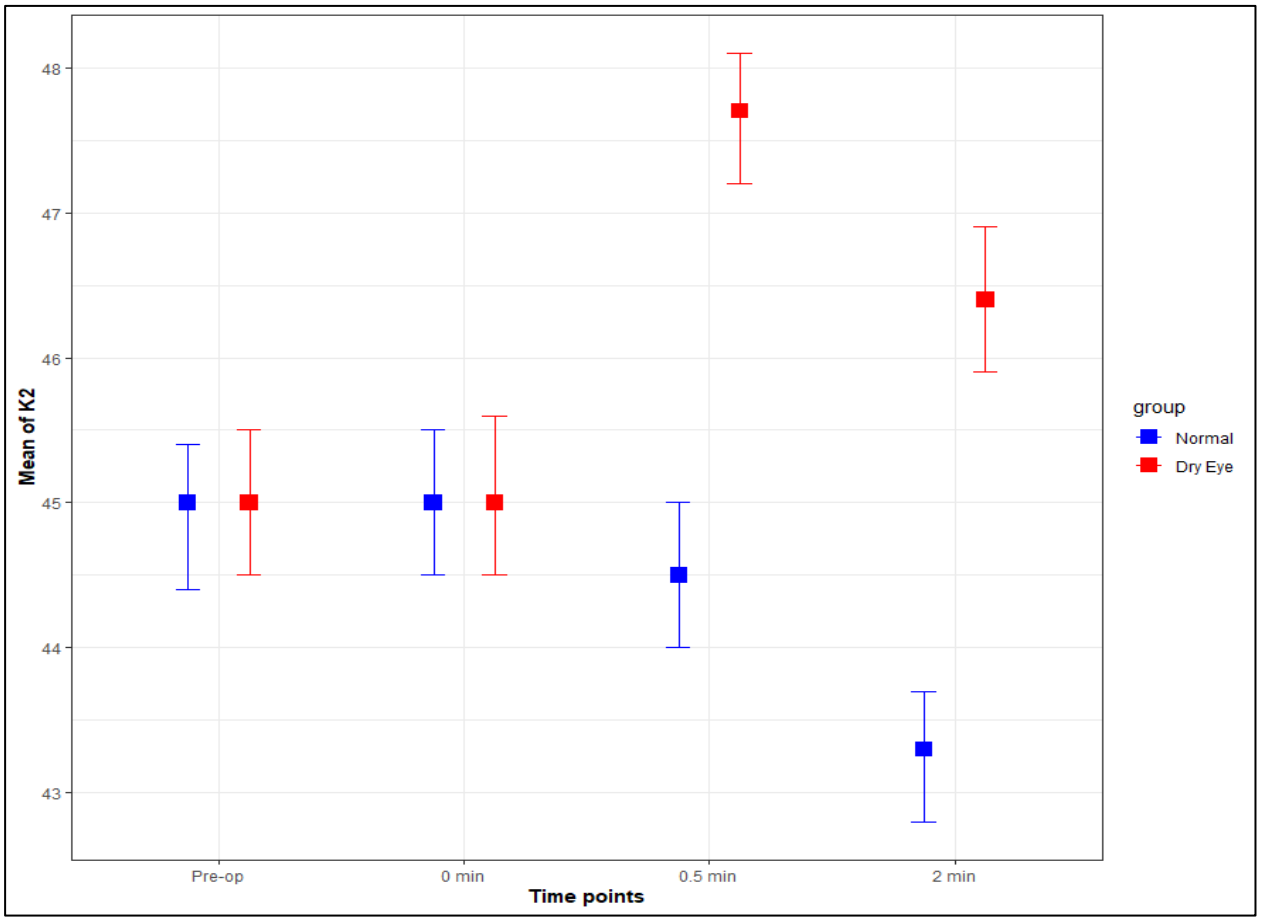

Figure 3. Comparison of K2 over time and groups

Key Findings:

- Significant differences in K1 and K2 readings were observed over various time points, especially in dry eye patients.
- For dry eye patients, significant changes in mean K values were noted between pre-op, 0.5 minutes, and 2 minutes post-instillation of eye drops.
- At 0.5 minutes and 2 minutes, mean K1 and K2 values were significantly different between normal and dry eye groups ($p < 0.0001$).

3.2 Discussion

This study highlights the variability of keratometric readings in patients with dry eye and the effects of artificial tears on these measurements. Artificial tears significantly influence K-readings, which can impact IOL power calculations. Previous studies have shown similar findings, with artificial tears improving tear film quality but altering corneal measurements. Our results align with Montes-Mico et al., who reported significant changes in ocular aberrations following artificial tear instillation.

Limitations:

1) Measurements were not taken beyond 2 minutes post-instillation.
2) Lack of differentiation between mild and moderate dry eyes.

Focus on the autorefractometer data only, limiting conclusions for other devices like the IOL Master.

4 Conclusion

Eye drops should be used cautiously before performing keratometry during biometry. Ideally, keratometry should be delayed for more than 5 minutes after instilling artificial tears. This is particularly important for dry eyes, as their measurements tend to be less reliable due to higher variability. The viscosity of the eye drops also influences this interval.

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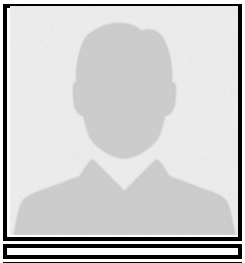

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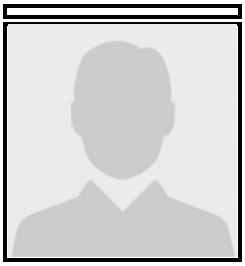

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