

Original article

Correlation between practice location as a surrogate for UV exposure and practice patterns to prevent corneal haze after photorefractive keratectomy (PRK)



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Abstract

Background: PRK is a refractive surgery that reshapes the corneal surface by excimer laser photoablation to correct refractive errors. The effect of increased ultraviolet (UV) exposure on promoting post-PRK corneal haze has been reported in the literature; however, information is lacking regarding the effect of ambient UV exposure on physician practice patterns. The aim of this study was to evaluate the effect of ophthalmologists' practice location on their reported practice patterns to prevent post-PRK corneal haze.

Methods: A cross-sectional observational study was conducted through an online survey sent to ophthalmologists performing PRK. The survey recorded the primary city of practice from which the two independent variables, latitude and average annual sunshine days, were determined. It also measured the frequency of use of postoperative preventive interventions (dependent variables) which are as follows: intraoperative Mitomycin-C, oral vitamin C, sunglasses, topical corticosteroids, topical cyclosporine, oral tetracyclines and amniotic membrane graft.

Results: Fifty-one ophthalmologists completed the survey. Practice locations' mean latitude was 36.4 degrees north, and average sunshine days annually accounted for 60% of year days. There was no significant relation between latitude/average annual sunshine days and usual post-PRK prophylactic treatments ($P > 0.05$). The commonest protective maneuvers were sunglasses (78%), prolonged topical corticosteroids (57%), Mitomycin-C (39%) and oral vitamin C (37%).

Conclusion: We found no significant difference in ophthalmologists' practice patterns to prevent post-PRK corneal haze in relation to practice location latitude and average sunshine days. Moreover, the results demonstrated that the most widely used postoperative measures to prevent post-PRK haze are sunglasses, Mitomycin-C, topical corticosteroids, and oral Vitamin C.

Keywords: Photorefractive keratectomy, Refractive surgery, Corneal haze, UV, Mitomycin

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Abbreviations: PRK, photorefractive keratectomy, UV, ultraviolet, IRB, Institutional Review Board

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Introduction

Photorefractive Keratectomy (PRK) is a common refractive surgery that reshapes the corneal surface by excimer laser photoablation, aiming to effectively correct refractive errors while maintaining optimal corneal health and visual acuity. One of the major postoperative complications of this procedure is corneal haze that can jeopardize the quality of vision, especially during the initial postoperative months.¹

Clinical and laboratory research into this issue has been performed in an attempt to determine the factors that contribute to the development of corneal haze, and how best to prevent it. Several modifying factors were introduced and are being used in clinical practice to improve post-PRK corneal transparency such as intraoperative application of mitomycin-C, in addition to the usual topical postoperative regimen including antibiotics, corticosteroids, non-steroidal anti-inflammatory drugs and oral vitamin C.² Despite the introduction of these prophylactic treatments, a proportion of patients still develop corneal haze. Risk factors that increase the incidence and severity of corneal haze include high degrees of refractive errors and environmental factors such as ultraviolet (UV) light exposure.³ Several studies evaluated the correlation between the development of post-PRK corneal haze and increased exposure to UV light.^{3,4} Nagy and colleagues⁴ conducted an experimental animal study to assess the clinical and microscopic effects of UV-B light exposure on photokeratectomized rabbit eyes. The authors compared photokeratectomized rabbit eyes with and without additional postoperative UV-B irradiation, and concluded that high UV-B exposure should be avoided during early healing phase. The authors proposed that it exerts an augmenting effect as it clinically aggravates corneal haze with prolongation of the stromal healing response microscopically. Additionally, Stojanovic and Nitter³ reported that the risk of late onset corneal haze (LOCH), haze occurring 4–12 months post-PRK, is higher in areas with more UV exposure and thus, encouraged wearing protective sunglasses in the first year after surgery. Taken together all these experimental and clinical studies provide solid evidence regarding the enhancing effect that UV light exposure has on the development of corneal haze after PRK. However, data correlating practice location as a surrogate for UV light exposure and practice patterns is still lacking in the literature. To the best of our knowledge, this study is the first to evaluate the relationship between location of performing PRK and ophthalmologists' clinical practice patterns to prevent postoperative corneal haze. We hypothesized that clinical practice patterns to prevent post-PRK corneal haze are influenced by location of practice, justified by the fact that UV light exposure varies from one location to another.

Methods

This is a cross-sectional observational study conducted through an online survey sent to ophthalmologists perform-

ing PRK in different countries worldwide via the Cornea Society ListServ (Keranut) and the American Society of Cataract and Refractive Surgery ListServ. The survey recorded the primary city of practice from which the two independent variables, latitude and average annual sunshine days, were determined using Google search engine. The survey also measured the frequency of use of common postoperative preventive interventions (dependent variables) which are as follows: intraoperative Mitomycin-C, oral vitamin C, sunglasses, topical corticosteroids, topical cyclosporine, oral tetracyclines and amniotic membrane graft. Responses that did not include location of practice were not included in the analysis.

SPSS version 22.0 was used for data analysis. Descriptive statistics were calculated for all the options for each question for the latitude and average days of sunshine. If there were an adequate number of responses for each of the 3 options for a question then the Kruskal Wallis test was used to compare the latitude and average days of sunshine among them. If any option was chosen less than 5 times, it was merged with the next option and compared with the third option using Mann Whitney test. For example, for Intraoperative Mitomycin C, "Never or almost never" was selected only 2 times; it was merged with the next option "sometimes or in certain cases" and compared with "always or almost always". Level of statistical significance was 0.05.

This survey was performed in adherence to the tenets of the Declaration of Helsinki. The Institutional Review Board of King Khaled Eye Specialist Hospital approved the survey, and potential respondents were informed that the anonymous composite results would be used for research. As the participants are all physicians that voluntarily responded to an email survey and were submitting information in an anonymous fashion, the IRB felt that obtaining local IRB ethics approval for each participant's location would actually increase the risk of breach of privacy, and therefore was not indicated. The data set with location of practice was not submitted with the manuscript, as this could also jeopardize the privacy of the respondents.

Results

Fifty-one ophthalmologists responded to the survey. [Table 1](#) details the descriptive data for latitude and average days of sunshine in the reported practice locations. [Table 2](#) describes the data relating the two independent variables, practice location latitude and average annual sunshine days, to the frequency of usage of listed interventions to prevent post-PRK corneal haze. The most prevalent protective measure post-PRK was wearing sunglasses for UV protection, advised by more than three quarters (78.4%) of participating ophthalmologists "always or almost always". Topical corticosteroid application after the first postoperative month was the second most common intervention recommended by more than half of the participants. Intraoperative Mitomycin-C accounted for the 3rd most commonly used

Table 1. Descriptive data for latitude and average days of sunshine.

	N	Mean	Median	Standard deviation	Minimum	Maximum
Latitude	51	36.4170	37.3000	8.83299	6.23	59.95
Average days of sunshine per year	51	218.5882	214.0000	38.18176	133.00	300.00

Table 2. Descriptive data for postoperative interventions to prevent corneal haze in relation to the independent variables, latitude and average sunshine days.

	Frequency	Percent	Latitude				Average sunshine days			
			Min	Max	Median	P value	Min	Max	Median	p value
<i>Intraoperative Mitomycin C</i>										
Never, sometimes or in certain cases	26	47.1	19.92	59.95	39.73	0.391	152	265	211	0.177
Always or almost always	25	39.22	6.23	51.97	36.02		133	300	217	
<i>Oral Vitamin C</i>										
Never or almost never	19	41.2	6.23	47.62	35.23	0.677	152	292	214	0.92
Sometimes or in certain cases	7	13.7	17.37	51.97	39.73		133	300	214	
Always or almost always	18	37.3	19.92	59.95	38.69		160	281	206	
<i>Ultraviolet protection (e.g. sunglasses)</i>										
Never or almost never	5	9.8	26.37	42.27	36.02	0.692	178	292	265	0.189
Sometimes or in certain cases	4	9.8	25.78	51.97	39.97		133	249	200	
Always or almost always	35	78.4	6.23	59.95	36.00		152	300	214	
<i>Topical corticosteroids beyond initial one month post-operative period</i>										
Never or Almost never	9	19.6	19.92	59.95	36.02	0.752	196	292	214	0.489
Sometimes or in certain cases	9	17.6	25.78	46.88	34.00		167	284	197	
Always or almost always	26	56.9	6.23	51.97	39.68		133	300	214	
<i>Topical cyclosporine (e.g. Restasis)</i>										
Never or almost never	28	54.9	6.2	59.9	38.19	0.381	133	300	214	0.338
Sometimes or in certain cases (or) always or almost always	17	33.3	5.5	45.70	31.40		167	284	208	
<i>Amniotic membrane graft</i>										
Never or almost never	43	88.2	6.23	59.95	36.02	n/a	133	300	214	n/a
Sometimes or in certain cases	1	2								
<i>Oral tetracycline, doxycycline or minocycline</i>										
Never or almost never	35	68.6	6.23	59.95	36.02	0.375	152	300	214	0.332
Sometimes or in certain cases (or) always or almost always	10	19.6	32.47	51.97	39.58		133	284	199	

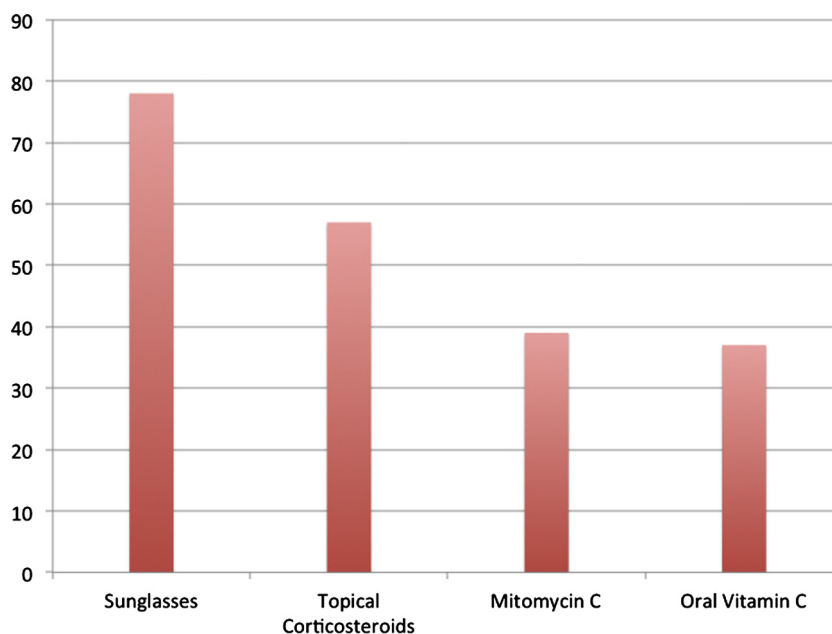


Figure 1. The most commonly used treatments to prevent the development of corneal haze post-PRK, reported as % of respondents using “Always or almost always”.

protective intervention where less than 5% never/almost never used it. Less popular interventions included oral vitamin C, topical cyclosporine, oral tetracyclines and rarely amniotic membrane graft. Fig. 1 represents the relative frequencies of reported usage of these common protective measures.

Discussion

The augmenting effect of UV irradiation on corneal haze development was presented in several previous studies.²⁻⁴ This study investigated the impact of practice location on practice patterns to prevent post-PRK corneal haze and

found no significant influence, although more than 50% of year days were sunny on average in practice cities. This could be attributed in part to the limited sample size in our study, which could be underpowered to find an association of smaller magnitude. In addition, one of the weaknesses of any survey is the non-random selection of ophthalmologists responding to the online survey. Variations in individual patient UV exposure, due to patient demographics and lifestyle or occupational factors, also cannot be controlled in a survey such as this. An additional uncontrolled variable is the surgeons' indication for MMC (such as patient age, depth of ablation, or other factors) or application technique.

Mitomycin-C and corticosteroids were among the most commonly prescribed prophylactic treatments. Previously conducted experimental and clinical studies affirmed the success of Mitomycin-C in preventing haze occurrence.⁵⁻⁸ It is noteworthy that only 2 respondents (4%) reported "Never or almost never" using intraoperative mitomycin. Nien and colleagues ascertained the efficacy of corticosteroids in reducing short-term post-PRK haze when its use was compared to cyclosporine.⁷ Therefore, we propose that the currently used methods of preventing corneal haze is effective, such that additional measures are not typically required, even in environments with higher UV exposure. Hence, the effectiveness of current surgical techniques and postoperative regimens could explain why practice location with greater UV exposure was not associated with an alteration in practice patterns.

Conclusion

In spite of the relation between UV light exposure and development of corneal haze, in this study we found no significant variance in ophthalmologists' practice patterns to prevent post-PRK corneal haze based on practice location latitude and average days of sunshine. Moreover, the results demonstrated that the most widely used postoperative preventive measures are sunglasses, mitomycin-C, topical corticosteroids, and vitamin C. Oral tetracyclines and amniotic membrane grafts are being used infrequently. It remains to be determined which interventions are necessary and which are superfluous, to avoid unnecessary medications or lifestyle modifications. Such studies may still be best performed with consideration given to the ambient UV exposure, but a prospective randomized controlled trial will be required to definitively determine the effect of environmental UV irradiation upon any particular PRK regimen.

Conflict of interest

The Authors have no relevant financial or non-financial conflict of interest to disclose.

Author's contributions

DUS participated in design of the study, interpretation of data, and revision of final manuscript. EMS participated in collection and interpretation of data and writing of the manuscript. Both authors approved the final manuscript.

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