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Research Article

EFFECT OF EYE OINTMENT ON OCULAR ABERRATION: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

An eye ointment was investigated for its influence on ocular aberration. Analyses were conducted using a prospective, comparative design. Using 10 normal volunteers, ocular aberration was measured before and after administration ofloxacin eye ointment for five minutes, 30 minutes, one hour, two hours, three hours, and twelve hours. A total of four higher-order aberrations (HOAs) were measured sequentially over 10 seconds, and their root mean square (RMS) was calculated. The fluctuations in the total HOAs over 10 seconds were used to calculate a fluctuation index (FI). In a study using gel-forming ophthalmic solution containing timolol maleate, we compared the results with other patients. The second-order RMS was not significantly altered by ointment administration. As a result of the study, significantly different HOAs were observed in third-, fourth-, and total higher-order RMS during the study period. A significant increase in RMS was observed 5 minutes after administration of each component of the HOA. Five minutes after administration, FI increased significantly, but SI remained unchanged. A Mann-Whitney U-test showed that HOAs and FI values after 6 h had significantly higher values compared with the gel-forming solution group. A significant increase and oscillation of HOAs occurs when eye ointment is administered. It is important to note that these changes were more pronounced than those observed after several hours' instillation or gel-forming ophthalmic solution.

Keywords:- Eye, Ointment, Ofloxacin, Volunteers.

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INTRODUCTION

Eye ointments ensure better drug bioavailability by reducing tear dilution, increasing contact time with the eye, and resisting nasolacrimal drainage. Their base is petroleum based and mineral oil based. As a result, they provide superior drug bioavailability by utilizing hydrophilic lipids such as lanolin and polyethylene glycol [1-3]. The use of these devices in clinical practice is widespread. Infections can be treated or prevented with some ointments that contain antibiotics, while exposure keratopathy can be treated or prevented by others that provide lubrication. It is still routinely applied at the end of surgery to apply antibiotic ointments into the conjunctival fornix [4]. To prevent bacterial colonization of the eyelid margins, antibiotic ointments are also commonly used prior to surgery [5]. Rather than eyedrops, antibiotic ointments are often used to treat blepharitis or eyelid infections [6,7]. Drugs such as fluorometholone and chloramphenicol can also be administered in eyedrops rather than ointments to achieve a higher aqueous level [8-10]. Dry eye and keratoconjunctivitis sicca are also treated with eye ointments [11–13]. Clinical practice continues to utilize eye ointments as a treatment option.

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Despite the fact that eye ointments have a severe impact on visual performance, many studies are underperforming on the impact of eye ointments on optical quality.

It is imperative to analyze the optical impact of eye ointments and inform patients and practitioners of such effects, due to the widespread use of eye ointments from children to the elderly. Refractive errors can be more accurately measured using wavefront analysis. The wavefront property of light is used to assess optical errors in the ocular eye by using wavefront sensors, and wavefront aberrations can be measured from the viewpoint of wavefront aberrations, and information can be obtained regarding lower-order aberrations (defocus and astigmatism), as well as higher-order aberrations (HOAs), which were previously unmeasurable. Images formed on the retina are affected by both lower-order and higher-order wavefront aberrations. It is possible to obtain an in-depth understanding of ocular optical quality by using this technique.

By measuring the time course of ocular wavefront aberration changes after administration of an eye ointment, we objectively and quantitatively assessed its influence on optical quality of the eye.

The ofloxacin eye ointment was employed as a representative drug in this study since it is a commonly used eye ointment. Recently, there have been some gel-forming ophthalmic solutions available in clinical practice that to extend corneal contact time and prolong ocular retention, thus allowing for greater ocular penetration. After administering these eyedrops, a transient blurring of vision is common [11-14]. In previous studies, we found significant increases in HOAs following the administration of a gel-forming solution for B5 minutes. The present results of the study were also compared with those of the previous study.

SUBJECTS AND METHODS

During the study, four eyes of each of 20 normal volunteers (twenty participants totaling 8 males and 12 females with a mean age of 36.4 years and 13.8 standard deviations) were enrolled, except for patients with refractive errors.

The study did not include people who wear contact lenses. No eye surgery or trauma had ever been performed on them, there was no dry eye symptoms, and they didn't use eyedrops regularly.

The best-corrected visual acuity of all subjects was better at the time of enrollment. Following a detailed explanation of the study's nature and possible consequences, all study participants gave their informed consent. Since left and right aberration patterns of a subject are generally symmetrical, only the right eye was used for measurement. There have been numerous detailed descriptions of this system. A series of ten images was taken after a blink every 1 s for a period of 10 seconds.

It was instructed to keep the subjects' eyelids open while they were capturing the images. A glass rod with a calibrated grid was then used to measure the length of the ofloxacin eye ointment, followed by application to the inferior. A base of white petrolatum and purified lanolin makes up the ointment, which contains ofloxacin, paraffin, liquid paraffin, and white petrolatum. A natural blinking period of 30 seconds was then allowed for the eyes [15]. We performed the same measurements five and thirty minutes after administration as well as one, two, three, six, and twelve hours afterwards. It was prescribed not to wipe the margins of the subject's eyelids during the entire study. On the same day, all measurements were performed in a room with a temperature of 23.4°C and a relative humidity of 52.1%.

A normalized Zernike polynomial was applied to the acquired data sets. The RMS for the second-, third-, fourth-, and total HOAs in the center of a 4-mm diameter was calculated based on the Zernike coefficients.

Third- and higher-order aberrations cannot be corrected by spherocylindrical lenses, but second-order aberrations can be corrected by them. HOAs are therefore classified as third- and greater-order aberrations. A spherical-like aberration is defined as a RMS of the third-order Zernike coefficient and a RMS of the fourth-order Zernike coefficient. In this study, third- and fourth-order Zernike coefficients were combined to calculate total HOAs. According to the study, quantitative indices were calculated from the sequential progression of ocular aberrations over time, such as the fluctuation index (FI) and stability index (SI).

In the serial measurements of 10 seconds, the FI represents fluctuations in the HOAs. Based on the total HOAs obtained during the measurement, the standard deviation is calculated. SI represents the trend in sequential changes in HOAs during measurement. It is calculated by dividing the slope of the linear regression line by the total number of HOAs.

Using repeated-measures analysis of variance, the obtained data for 10 s was averaged for each eye and analyzed to determine how each aberration changed over a period of 12 hours. Dunnett posthoc test for multiple comparisons was used to find significant differences from baseline based on time points where significant differences were observed. Further, Mann–Whitney U-tests were used to compare the obtained data with early data on ocular wavefront aberrations of 17 normal volunteers treated with 0.5% timolol maleate gel-forming solution.

Table 1: Comparison of baseline characteristics between eye ointment and gel-forming solution subjects

	*Eye ointment group (*n ¼ *20)*	*Gel-forming solution group (*n ¼ *34)*	P-*value*
Sex	Male: 8, Female: 12	Male: 20, Female: 14	0.5686
Age (years)	36.4±13.8	38.3±16.2	0.79
Breakup time (in seconds)	9.4±0.8	9.2±1.4	0.176
Schirmer test (mm)	33.2±1.4	30.9±6.8	0.277

RESULTS

As a result of the eye ointment, the second-order RMS did not significantly change over time (P 14 0.8, repeated measures ANOVA). In the study period, higher-order RMS like third- and fourth-order RMS changed significantly. The RMS values for each HOA component were significantly higher after the administration of eye ointment than at baseline, as determined by multiple comparisons. Eventually, all aberrations returned to their pre-administration levels, but some fluctuations persisted. Within 12 hours after eye ointment administration, there was a significant change in FI. Five minutes after administration, FI significantly increased, and then returned to preadministration levels. A repeated-measures ANOVA revealed no significant change in SI following application of eye ointment (P 14.807).

In addition, the present results were compared with those of the prior study in which timolol gel-forming solution was used. Table 1 shows that age, sex, Schirmer values, and breakup time were not significantly different between the two studies. A significant difference was not found in the second-order RMS between the two study groups during the study period. After 5 minutes and 6 hours following application, third-order RMS for HOAs was significantly different between the two groups. Thirty minutes, one hour, and two hours after the application, fourthorder RMS showed significant differences between the two groups. Immediately after application, 5 minutes, 30 minutes, and 2 hours later, the higher-order RMS was significantly different between the two groups. Following application, there was a significant difference in FI between the groups at 5 minutes, 30 minutes, and 2 hours, and 3 hours. The results of the study did not find any significant differences in SI between the two groups. A representative case using gel-forming solution versus eye ointment was analyzed for the change in color-coded maps of HOAs.

DISCUSSION

An essential optical element of the eye is the tear film, which is necessary for maintaining ocular optical quality by maintaining stability and regularity. An increase in thickness or smoothness of the tear film can have a significant impact on optical aberrations. According to numerous studies so far, tear film instability causes increased aberrations that deteriorate image quality. In order to obtain high-quality retinal images, it is essential to maintain a smooth and intact tear film. As the quality of the optical image deteriorates, it is not a static phenomenon, but a dynamic one, and increasing attention is being paid to the sequential changes in tear film dynamics over time, since these changes correspond to changes in the optical image. Dry eyes and normal eyes have been studied in regard to tear film dynamics and sequential wavefront aberrations [16, 17]. As a practical objective method for evaluating successive changes in the optical quality of the eye, wavefront sensing has increasingly been recognized as a viable option. Our objective was to determine how eye ointment effect ocular optical clarity by examining the sequential changes in ocular aberrations using the wavefront aberrometer.

CONCLUSION

Thus, sequential analysis of wavefront aberration following application of eye ointment allows for the extraction of information that has not been possible using conventional methods in the past. Several hours after application of the eye ointment, we quantified its greater optical effect than the gelforming solution on HOAs. The use of eye ointments may directly cause patients to complain of blurred vision. These results suggest that patients should be appropriately informed about the potential decrease in optical quality of the eyes, especially in cases where daily use is unavoidable. Several hours after the administration, you should not drive or perform any other activity that requires good vision. However, eye ointment has a substantial impact on optical quality despite its excellent effect on extending the drug's effect. A good bioavailability and reduced visual impact are therefore desirable in alternative drug delivery systems.

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