ORIGINAL ARTICLE

Effects of osmoprotective eye drops on tear osmolarity in contact lens wearers

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ABSTRACT • RÉSUMÉ

Objective: To evaluate the impact of osmoprotective eye drops on tear osmolarity and patient comfort, and to compare its efficacy with a commercially available lubricant in contact lens (CL) wearers.

Design: Prospective, cross-sectional study.

Participants: Forty eyes of 20 first-time CL wearers were included.

Methods: Tear osmolarity measurements using TearLab osmolarity system were performed in each eye of subjects at 8 AM, and 2, 4, and 8 h after that on the first and second days, and at 12:00 on the third day and eighth days. On the second day and afterward, all eyes were fitted Purevision 2 (Bausch & Lomb) soft CLs. Subjects instilled Optive (Allergan) osmoprotective eye drops into their 1 eye (group 1) and Refresh tears (Allergan) eye drops into their other eyes (group 2) after 2 hours of CL wear on the third day and afterward. Ocular comfort with eye drops was also assessed.

Results: There were no significant differences between the tear osmolarity measurements of the groups on the first day. On the second day, osmolarity significantly increased from baseline after 4 h of CL wear ($p < 0.05$) but returned to baseline after 8 h of CL wear ($p > 0.05$) in both groups. Tear osmolarity measurements of group 1 were significantly lower than those of group 2 on the third and eighth days (both $p < 0.05$). The mean comfort scores were significantly higher in group 1.

Conclusions: Tear osmolarity increases within the first hours of CL wear, and instillation of osmoprotective eye drops prevents this increment in patients wearing CLs.

Objet : Évaluer l'effet de gouttes ophtalmiques osmoprotectrices sur l'osmolarité des larmes et sur le confort du patient, et comparer leur efficacité avec celle d'un lubrifiant du commerce chez des porteurs de lentilles cornéennes.

Nature : Étude transversale prospective.

Participants : 40 yeux de 20 sujets portant des lentilles cornéennes pour la première fois.

Méthodes : À l'aide du système TearLab, on a mesuré l'osmolarité des larmes de chaque œil des sujets à 8 h ainsi que 2 heures, 4 heures et 8 heures plus tard le premier et le deuxième jour, puis à 12 h le troisième et le huitième jour. Le deuxième jour et les suivants, tous les yeux ont reçu des lentilles souples Purevision 2 (Bausch & Lomb). Le troisième jour et les suivants, après 2 heures de port des lentilles, les sujets se sont instillé des gouttes ophtalmiques osmoprotectrices Optive (Allergan) dans un œil (groupe 1) et des gouttes Refresh Tears (Allergan) dans l'autre œil (groupe 2). On a aussi évalué le confort oculaire avec les gouttes ophtalmiques.

Résultats : Il n'y avait pas de différence significative entre les mesures de l'osmolarité des larmes des deux groupes le premier jour. Le deuxième jour, l'osmolarité avait significativement augmenté par rapport au niveau de référence après 4 heures de port des lentilles cornéennes ($p < 0,05$), mais elle avait rebaissé au niveau de référence après 8 heures de port ($p > 0,05$), dans les deux groupes. Les mesures de l'osmolarité des larmes du groupe 1 étaient significativement plus faibles que celles du groupe 2 le troisième et le huitième jour ($p < 0,05$ dans les ceux cas). Les scores moyens relatifs au confort étaient significativement plus élevés dans le groupe 1.

Conclusions : L'osmolarité des larmes augmente pendant les premières heures de port de lentilles cornéennes, et l'instillation de gouttes ophtalmiques osmoprotectrices empêche cette augmentation chez les porteurs de lentilles cornéennes.

Contact lenses (CLS) are popular, and many people use CLs as an optical correction every day. Unfortunately, it was found that up to 50.1% of CL wearers report dryness sensation compared with just 21.7% of nonlens wearers.[1] The presence of a CL has been shown to adversely affect the tear film characteristics, increase tear evaporation, and reduce the ability to produce adequate tears with concurrent increase in tear osmolarity.[2–6] It has been suggested that increased tear osmolarity may accompany CL-related dry eye, and even the most contemporary CL types (i.e., silicone hydrogel lenses) can elevate the tear osmolarity.[6,7]

Lubricant eye drops are the accepted first-line treatment when a patient has signs or symptoms of dry eye disease. A questionnaire by Begley et al.[8] showed that 24% of mostly successful CL wearers use artificial tears or CL rewetting drops. In general, artificial tears moisturize the eye surface by simply increasing the water content of the tear film or by preventing tear evaporation, and protect the ocular surface by reducing friction between eyelids and the cornea.[9] The International Dry Eye Workshop reported that dry eye is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface, and early

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intervention could disrupt the core mechanism that drives dry eye.[10] Thus, if lubricant eye drops improve the ocular surface health and have active ingredients that do more than lubricate, progression of the condition may be arrested.

Optive eye drop (Allergan, Irvine, Calif.) is a relatively new lubricant shown to improve the quality and stability of the tear film.[11] It contains erythritol and L-carnitine osmolytes that have been shown to provide the osmoprotection.[12,13] Although it has been previously suggested that CL wearers carry a high risk for development of dry eye with concurrent increase in tear osmolarity, to our knowledge, none of the studies evaluated the effects of osmoprotective eye drops in this particular population. Therefore, in this study, we aimed to assess the efficacy of an osmoprotective eye drop in restoring the physiologic osmolarity of the tear in CL wearers and to compare its efficacy with a commercially available lubricant.

Methods

Subjects

This prospective study comprised 40 eyes of 20 subjects who applied to our clinic with a refractive error and wanted to use CLs. Subjects were recruited primarily from the staff of our university. All patients provided written, informed consent.

The study was approved by the local ethical committee and was performed in accordance with the ethical principles described in the Declaration of Helsinki. None of the subjects had ever worn CLs previously.

Study participants underwent a screening process that included a survey of general ophthalmologic or medical history, slit-lamp biomicroscopy, a tear film break-up time (TFBUT) test, and a Schirmer test with anesthesia. TFBUT was measured using a sterile fluorescein paper diluted with a nonpreserved, balanced salt solution. Each subject was also asked to complete the Ocular Surface Disease Index questionnaire.

Exclusion criteria included contraindication against lens wear, pathologic findings in biomicroscopical examination, history of refractive surgery, ocular or systemic disease, and use of any topical or systemic medication.

Table 1—Summary of the study procedure

First day of the study	• Osmolarity measurements in each eye of the subjects were taken at 8:00 AM, and 2, 4, and 8 h after it. • Subjects did not wear contact lens. • Subjects did not instill any eye drops.
Second day of the study	• Subjects wore contact lenses at 8:00 AM. • Osmolarity measurements in each eye of the subjects were taken before and after 2, 4, and 8 h of contact lens wear. • Subjects did not instill any eye drops.
Third to eighth day of the study	• Subjects wore contact lenses at 8:00 AM. • Subjects instilled Optive eye drop to 1 eye and Refresh tears eye drop to the other eye after 2 h of contact lens wear on the third, fourth, fifth, sixth, seventh, and eighth days of the study . • Osmolarity measurements of the subjects were taken after 4 h of contact lens wear on the third and eighth days.

Study procedure

Table 1 and Figure 1 summarize the study procedure. On the first day of the study, tear osmolarity measurement using TearLab osmolarity system (TearLab Corporation, San Diego, Calif.) was performed in each eye of subjects at 8 AM, and 2, 4, and 8 h after that.

On the second day and afterward, all eyes were fitted for balafilcon A (Purevision 2; Bausch&Lomb) silicone hydrogel soft CLs in daily wear protocol. Tear osmolarity measurement was performed before and after 2, 4, and 8 h of CL wear on the second day.

Subjects instilled Optive osmoprotective eye drops into 1 eye (group 1) and Refresh tears lubricant eye drops (Allergan) into their other eye (group 2) after 2 hours of CL wear on the third day and afterward. To minimize the potential risk for confusion in the use of drops (because of simultaneous use of both products) and to mask the subjects, we labeled the eye drops and gave them to the subjects with a cover as "right eye" or "left eye" according to the brand of artificial tear solutions. Also, subjects were called by phone to remind instillation of their eye drops every day on time to assure the usage of the drops. Because the tear osmolarity measurements were significantly different only after 4 h of CL wear on the second day in both groups, tear osmolarity measurements on the third and eighth days of the study were performed only after 4 h of CL wear. All subjects used the same CL care solution (Biotrue; Bausch&Lomb) during the study period.

Comfort assessment

Subjects were asked to use a grading scale to rate comfort (0 = very uncomfortable to 10 = very comfortable) of each eye by a masked observer (E.M.) after 4 and 8 h of CL wear on the third and eighth days.

Tear osmolarity measurement

The TearLab Osmolarity System is described as a "lab-on-a-chip" system that uses 50 nL tear sample to measure the osmolarity of the tear. The samples were analyzed, and the results were displayed on a portable reader unit, which measures tear osmolarity in mOsm/L from the inferior lateral meniscus. To ensure that the system was functioning normally, we calibrated the TearLab once per day using electronic test cards. The patients were seated such that their heads were positioned laterally upward and they were asked to look at the ceiling. To collect tears, the tip of the test card was positioned just above the lower eyelid so that it touched the tear meniscus.