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IN VIVO WETTABILITY OF HYDRAGLYDE® SILICONE HYDROGEL LENS WITH AND WITHOUT HYDRAGLYDE® CONTAINING LENS CARE SOLUTION

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ABSTRACT

Contact lens care solutions are readily available over-the-counter at any pharmacy, optical shop, or eye care specialist centers. The use of a non-compatible solution may damage or alter the material of the contact lens, and may cause changes in the efficiency of the lens, thereby reducing comfort of the wearer. Hence, this research was carried out to determine the wettability of HydraGlyde® Silicone Hydrogel lens with and without HydraGlyde® containing lens care solutions. The right eye of 25 subjects (mean age: 22.8 ± 1.3 years old) were studied. The subjects needed to come for two visits [1 week apart] at approximately the same time of the day. Each subject received the pre-soaked lenses with and without HydraGlyde® Moisture Matrix randomly. The subjects wore the lenses for 8 h. Non-Invasive Tear Breakup Time (NIKBUT) was measured using OCULUS® Keratograph 5M, followed by a subjective questionnaire response.

Parametric paired t-test showed no significant differences in PLTF NIKBUT baseline (16.25 ± 3.75 s) and after 8 h of lens wear (15.02 ± 3.81 s) when lenses soaked in a solution with HydraGlyde® Moisture Matrix ($p > 0.05$). However, a significant difference was found in PLTF NIKBUT baseline (16.16 ± 2.79 s), and after 8 h of lens wear (14.74 ± 3.73 s) when lenses were soaked in a solution without HydraGlyde® Moisture Matrix ($p < 0.05$). The change in the PLTF NIKBUT baseline and after 8 h of lens wear for the solution with and without HydraGlyde® Moisture Matrix (−1.23 ± 3.89 s and 1.68 ± 3.58 s respectively) were not statistically significant ($p > 0.05$). The subjective questionnaire revealed a preference towards a solution with HydraGlyde® Moisture Matrix with a mean score of 68.84 ± 15.36% compared to without HydraGlyde® Moisture Matrix with a mean score of 62.80 ± 14.00% ($p < 0.05$). A lens care solution containing HydraGlyde® Moisture Matrix is advised to be prescribed along with HydraGlyde® silicone hydrogel lens to achieve optimum lens performance.

Keywords: contact lens; HydraGlyde® Moisture Matrix; NIKBUT; OCULUS Keratograph 5M; wettability

INTRODUCTION

In recent years, soft contact lens wearers accounted for about 80% of new fit, and silicone hydrogel accounted for about 50% of all contact lens fitted internationally, and it is expected to grow throughout the years.[1] Although, with the introduction of new technologies and designs on soft contact lenses and contact lens care solutions, discomfort is always the primary cause that leads to an increase in contact lens dropout rate. Hence, improving comfort by increasing moisture is always the priority of contact lens manufacturers.

HydraGlyde® Moisture Matrix is a wetting agent designed by Alcon Laboratories Inc., Fort Worth, Texas. It is a di-block copolymer (EOBO). EOBO is divided into two groups: hydrophobic and hydrophilic. When the hydrophobic part of EOBO is attached to the hydrophobic site of contact lenses, it will allow the hydrophilic portion of EOBO to attract water and retain its moisture content.[2]

The term "wettability" in the eye refers to the ability and the duration the tear film stays on the surface of the contact lens.[3] When a contact lens is fitted into the eye, the precorneal tear film (PCTF) splits into pre-lens tear film (PLTF).[4] To measure soft contact lens wettability, it can be broken down into laboratory-based (*In Vitro* and *Ex Vivo*) and clinical (*In Vivo*) assessments. A laboratory-based assessment is done by measuring the contact angle of the ability of a fluid spread over the surface of the contact lens. When it comes to clinical assessments, there are various non-invasive in vivo methods to measure the PLTF, such as a slit-lamp bio microscope with subjective grading of the PLTF, non-invasive Keratograph tear break-up time (NIKBUT), and Tear Film Interferometer (TFI).[4–6]

METHODS

An experimental, double-mask study was conducted at SEGi EyeCare Clinic, SEGi University, Malaysia. The Research and Innovation Management Center approved the study – SEGi University (SEGiIRF/2020-02/FoOVS-1/76), and it followed the Declaration of Helsinki's tenets. The subjects signed an informed consent form before participating in the study. The subjects were selected based on random sampling method without any previous contact lens related complications such as dry eye, corneal staining, conjunctiva staining, giant papillary conjunctivitis, contact lens induced acute red eye, neovascularization, and corneal abrasion.

The subjects were required to come for two visits, each visit being 1 week (wash-off period) apart. Both visits were conducted at approximately the same time, and NIKBUT was measured using OCULUS® Keratograph 5M. HydraGlyde® silicone hydrogel lenses were pre-soaked in a solution with HydraGlyde® Moisture Matrix (solution A) and a solution without HydraGlyde® Moisture Matrix (solution B). The details and parameters are shown in Appendix 1. Each subject received the pre-soaked lenses randomly at each visit, and the subject wore the lenses for 8 h continuously on the same day. They were also required to fill up a subjective questionnaire before and after 8 h of wearing the lens.

RESULTS

The right eye of twenty-five subjects, nine male (36%) and sixteen female (64%), with the mean age of 22.8 ± 1.3 years old were studied. All the data obtained were normally distributed, and hence, a parametric paired t-test was used for statistical analysis. No significant difference was seen in the PLTF NIKBUT baseline and after 8 h of lens wear soaked in solution A [$t(25) = 1.58$, $p = 0.13$]. However, there was a significant difference in PLTF NIKBUT baseline and after 8 h of lens wear soaked in solution B [$t(25) = 2.35$, $p = 0.03$]. But, the change of the PLTF NIKBUT baseline and after 8 h of lens wear was not statistically significant in either solution [$t(25) = 0.41$, $p = 0.69$]. The mean, standard deviation, and p-value are shown in Table 1. Mean (sec) and Standard Deviation (S.D.) of PLTF NIKBUT baseline and PLTF NIKBUT after 8 h of wear of solution A and B are shown in Figure 1.

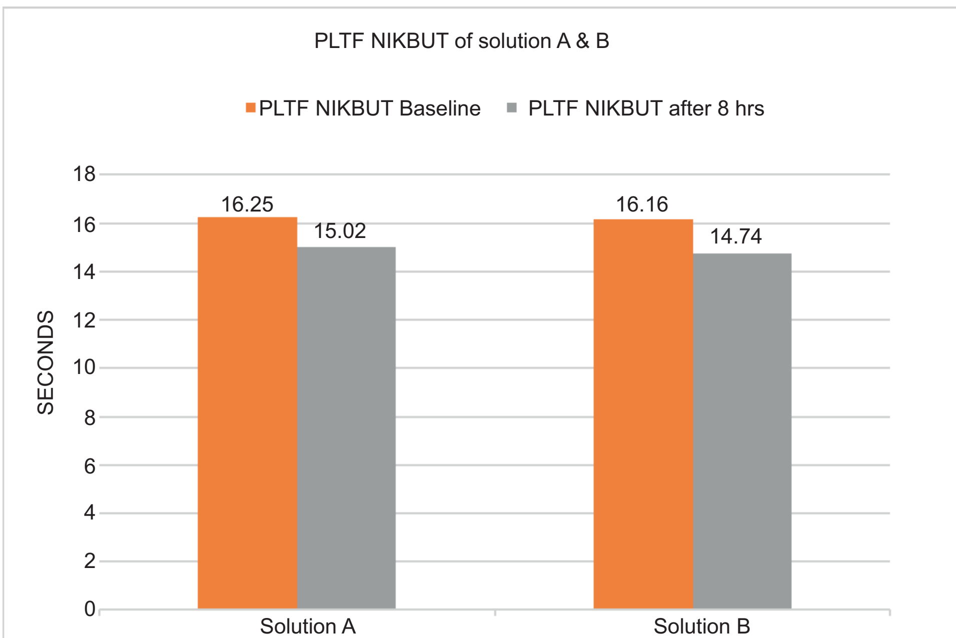
Besides, the subjects were also asked to answer a subjective questionnaire to describe their comfort and satisfaction towards the lens soaked with different solutions. There was a significant difference in their preferences. The subjects preferred the solution with HydraGlyde® Moisture Matrix over the solution without HydraGlyde® Moisture Matrix [$t(25) = 2.08$, $p = 0.05$]. The mean, standard deviation, and p-value are shown in Table 2.

TABLE 1 The mean, standard deviation, p-value for pre-lens tear film non-invasive Keratograph tear breakup time baseline, pre-lens tear film non-invasive Keratograph tear breakup time after 8 h of wear and the change in non-invasive Keratograph tear breakup time of solution A and B.

	Mean (sec) ± S.D.	p value
PLTF NIKBUT baseline (Solution A) PLTF NIKBUT after 8 h of wear (Solution A)	16.25 ± 3.75 15.02 ± 3.81	p = 0.13
PLTF NIKBUT baseline (Solution B) PLTF NIKBUT after 8 h of wear (Solution B)	16.16 ± 2.79 14.74 ± 3.73	p = 0.03
Change in NIKBUT (Baseline and after 8 h of wear) Solution A Solution B	 −1.23 ± 3.89 −1.68 ± 3.58	p = 0.69

SD – Standard deviation; PLTF NIKBUT – Pre-lens tear film non-invasive Keratograph tear break-up time.

FIG. 1. Mean (sec) of PLTF NIKBUT baseline and PLTF NIKBUT after 8 h of wear of solution A & B.



DISCUSSION

The present study found a reduction in PLTF NIKBUT after 8 h of lens wear, which agrees with a previous study in which both NIKBUT and Tear Meniscus Height (TMH) of PLTF reduces after 6 h of wear despite the type of contact lens wear when compared with bare eyes.[7] According to another study, the PLTF will become unstable and quickly disrupted a short period after blinking.[8] This could be possible because, after 8 h of contact lens wear, the lipid layer of pre-lens will spread slower; hence it will decrease the lens's wettability.[9]

There is a significant difference in PLTF NIKBUT baseline, and after 8 h of lens wear when soaked in solution without HydraGlyde® Moisture

TABLE 2 The mean, standard deviation and p-value of subjective questionnaire's score for Solution A and Solution B.

	Mean (score %) ± S.D	p value
Solution A	68.84 ± 15.36	p = 0.05
Solution B	62.80 ± 14.00	

SD – Standard deviation.

Matrix. It was found that there is no significant difference for lenses soaked in a solution with HydraGlyde® Moisture Matrix. This shows that HydraGlyde® Moisture Matrix has played an essential role in maintaining lens wettability. It is a specifically designed wetting agent that is incorporated in OPTI-FREE® PureMoist® multi-purpose disinfecting solution. It is a proprietary multi-functional linear di-block copolymer composed of poly (oxyethylene)-poly (oxybutylene) (EOBO). In combination with TETRONIC 1304 (BASF Corporation), EOBO also acts as a surface acting agent by reducing the surface and bulk hydrophobicity of silicone hydrogel lenses, and improving the hydrophilic surface properties, thereby improving lubrication and wettability for at least 16 h.[10]

A previous study also shows that contact lens de-wetting is longer when soaked in OPTI-FREE® PureMoist® multi-purpose disinfecting solution than a saline solution.[11] This finding was consistent throughout the previous contact lens wettability studies when tested with a commercially available contact lens, which found that OPTI-FREE® PureMoist® multi-purpose disinfecting solution was associated with a higher wettability than saline solutions.[12,13] However, the change in PLTF NIKBUT for lenses soaked in a solution with HydraGlyde® Moisture Matrix (−1.23 ± 3.89 s) and a solution without HydraGlyde® Moisture Matrix (−1.68 ± 3.58 s) was not significant. This shows that both solutions can provide successful wear for contact lens wearer. According to the study, the recommended NIKBUT value for a successful wear was 5.9 ± 4.3 s.[14]

Based on the subjective questionnaire favouring a solution, HydraGlyde® Moisture Matrix was found to be the favoured one in this study. It was also found that subjects favoured HydraGlyde® Moisture Matrix containing lens care solution as it enhances the patient's wearing experience and maintains optimal lens performance throughout the day. Most of the subjects have responded: "I can comfortably wear my lenses," "My lenses feel moist from morning until evening," and "My lenses are comfortable from morning until evening," in the questionnaire.[10] Another study also reported a similar result, as subjects favoured a solution containing HydraGlyde® Moisture Matrix on day 30 of the study, and responded: "I can comfortably wear my lenses" and "provides comfortable lens wear time."[2]

CONCLUSION

The use of a wetting agent in contact lens solutions such as HydraGlyde® Moisture Matrix improved the wettability of the lens and comfort level of the lens wear from this study. Hence, the lens care solution containing HydraGlyde® Moisture Matrix could be advised to prescribe along with HydraGlyde® silicone hydrogel lenses to provide more comfort level and achieve optimum lens performance.

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APPENDIX 1

A. Lens material and parameters

Type	Material	Power (D)	Base curve (mm)	Diameter (mm)	Center thickness @ –3.00D (mm)	Water content (%)
Silicone hydrogel	lotrafilcon B with HydraGlyde® Moisture Matrix	+8.00D to –12.00D	8.6	14.2	0.08mm @ –3.00D	33

B. Lens care solutions

Solution A (with HydraGlyde® Moisture Matrix)	multi-purpose disinfecting solution, sterile, buffered, aqueous solution containing sodium citrate, sodium chloride, boric acid, sorbitol, aminomethylpropanol, disodium EDTA, TETRONIC® 1304+, HydraGlyde® Moisture Matrix with POLYQUAD® 0.001% and ALDOX® 0.0006% preservatives
Solution B (without HydraGlyde® Moisture Matrix)	multi-purpose disinfecting solution, sterile, buffered, isotonic, aqueous solution containing sodium citrate, sodium chloride, boric acid, sorbitol, aminomethylpropanol, TETRONIC® 1304+, with edetate disodium 0.05%, POLYQUAD® 0.001% and ALDOX® 0.005% preservatives