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Daily versus monthly disposable contact lens: Which is better for ocular surface physiology and comfort?

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ABSTRACT

Purpose: To investigate the effect of soft contact lenses (SCL) wearing modality and lens materials on the changes in conjunctival bulbar and limbal redness and conjunctival and corneal staining after two months of SCL wear. Comfort level was also analyzed.

Methods: In this longitudinal clinical trial, forty-seven neophyte myopic subjects were fitted with a monthly disposable lens (lotrafilcon-B or comfilcon-A or balafilcon-A) in one eye and a daily disposable lens (nelfilcon-A or stenofilcon-A or nesofilcon-A) in the other eye, randomly selected. Conjunctival bulbar and limbal redness and conjunctival and corneal staining were evaluated before and after lens wear. Effect of lens wearing modality and lens materials on these changes was also determined. Level of comfort was evaluated subjectively twice per day. Comfort level and reduction in end-of-day comfort were compared between different lens wearing modalities and materials.

Results: Bulbar and limbal redness and conjunctival and corneal staining were increased ($p < 0.001$) after lens wear, and changes were similar with daily and monthly disposable lens wear ($p > 0.05$). Limbal redness was associated with lens materials, and lotrafilcon-B induced the least among the studied lenses ($p < 0.05$). There was no significant association between the wearing modality and the average comfort level and reduction of end-of-day comfort ($p > 0.05$).

Conclusion: Two months of SCL wear increased conjunctival redness, conjunctival and corneal staining, which were not associated with the lens wearing modality. There was a reduction in end-of-day comfort, similar to daily and monthly lenses. The change in limbal redness and reduction in end-of-day comfort were associated with the characteristics of the lens material.

1. Introduction

Contact lenses (CL) wear can induce metabolic, mechanical and toxic effects on the ocular surface [1]. The metabolic effect is considerably related with the oxygen transmissibility (Dk/t) of the lens materials [2]. Mechanically, CL wear may affect corneal as well as conjunctival health, which depends upon the lens design and/or the lens material characteristics, such as Young's modulus [3]. Since soft contact lenses (SCL) may absorb different chemicals from the lens care solutions, toxic reactions can be induced when they are released on the ocular surface during wear [4]. Whatever may be the etiology of adverse effects of lens wear, they catalyze the inflammatory reaction, which is initially observed with conjunctival redness due to vasodilation and white blood cell migration.

Ocular redness is the principal sign of eye inflammation [5]. Generally, limbal redness indicates corneal problems while diffused bulbar redness indicates conjunctival problems. The majority of recent studies with silicone hydrogel lenses showed that ocular surface physiology is similar with and without lenses [6,7]. However, some studies pointed out that mechanical or inflammation related problems increase with silicone lenses in comparison to other hydrogel lenses [8,9]. Conjunctival physiology, including bulbar redness, limbal redness and staining, may be important factors for a successful CL wear; however, this area has not been extensively investigated.

Success in CL wear is determined by clear vision and comfort during full-time wear. With the availability of many lens designs and parameters, clear vision is easily maintained with proper lens selection. However, due to multifactorial etiology, comfort is always a challenge for CL wearers [10]. CL related discomfort might be due to the disruption of the tear film and the ocular homeostasis, which leads to increase tear evaporation, tear osmolarity, and as a consequence, a higher mechanical effect of the lens on the ocular surface [11]. It may also be related to lens movement, edge profile, dehydration, deposition, modulus and stiffness, surface wettability and lubricity and solution

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characteristics [12], and it diminishes or disappears after removing the lenses [13].

Currently, SCL are available for different wearing modalities, among these, daily and monthly disposable lenses are the most popular. Because wearing new lenses every day avoids the use of cleaning/storing chemicals, many clinicians prefer daily disposable lenses as the first choice. However, as far as the authors are aware, no studies have been done on the effect of lens wearing modality on the ocular surface physiology. Moreover, discomfort is one of the main factors of CL discontinuation [14,15], and recent studies show that end-of-day comfort in SCL wearers is lower than the comfort level just after insertion of the lenses [16–18]. The effect of lens wearing modality on the comfort level has also not been studied in the past.

The aims of this study were to determine the effect of lens wearing modality on conjunctival bulbar and limbal redness and conjunctival and corneal staining after two months of SCL wear. The effect of lens wearing modality on ocular comfort and reduction in end-of-day comfort was investigated. Effect of lens materials on ocular surface physiology and comfort was also studied.

2. Methods

A longitudinal, contra-lateral study was conducted in neophyte CL wearers at the University of Minho, Portugal. Each subject signed a consent form after the study protocol was explained. This study obtained ethical approval from the Ethical Committee of the School of Science of the University of Minho, and followed the tenets of the Declaration of Helsinki.

The study was conducted on myopic subjects with astigmatism less than 1.00D, who had never worn CL. Subjects with previous history of ocular surgery, eye pathology and systemic disease, or those presenting ocular findings equal to or over grade 2 in the Efron grading scale were excluded. They should have commitment to follow the protocol of the study. A sample size of at least 15 eyes for each brand of CL was necessary to warrant the power of 0.99, to detect a difference of 0.5 unit in limbal or bulbar redness and conjunctival or corneal staining with a p value of 0.05 [3].

Each subject wore a monthly disposable lens (lotrafilcon B or comfilcon A or balafilcon A) in one eye and a daily disposable lens (nelfilcon A or stenofilcon A or nesofilcon A) in the other eye, selected randomly. Lens fitting was examined, and if any unacceptable fitting was detected due to unsuitable lens parameter, another lens was fitted from the study lens group. Lens details are presented in Table 1. Monthly disposable lenses were worn on a daily wear basis, that means lenses were removed during the night and replaced every month. OPTIFREE Puremoist multipurpose disinfecting solution (Polyquad 0.001% and Aldox 0.0006%, Alcon Laboratories, TX) was provided for cleaning, storing and disinfecting monthly disposable lenses. Daily disposable lenses were discarded after single use. All subjects were properly instructed on lens fitting and handling procedures. During the dispensing time, lenses and lens care products were provided for a one-month period. The subjects were instructed to come for the follow-up visit after one month, and lenses and lens care products were provided for the following month.

During the first week, the number of wearing hours per day and number of wearing days per week were flexible; however, after the second week, all subjects were instructed to wear lenses at least 5 days per week and 8 h per day [19]. There was no limit for the wearing period, but lens wear during sleep and swimming was not allowed.

Slit lamp evaluation was performed on the baseline visit, 1st month follow-up visit and 2nd month follow-up (final) visit by a contact lens expert. Anterior segment photography with slit-lamp was performed to help the grading score analysis. Conjunctival redness was observed with white light of the slit lamp. Bulbar redness and limbal redness grading were performed in four regions: nasal, temporal, superior and inferior. Conjunctival staining was observed in four regions within 2 mm from the limbus after the application of Lissamine Green (Green GloTM, HUB Pharmaceuticals, LLC, CA, USA) [20]. Corneal staining was examined with the application of 1% fluorescein (Fluorescein Strips, Chauvin Pharmaceuticals Ltd, Montpellier, France), cobalt blue light filter and a Wratten 12 barrier filter [20]. This was quantified in five areas: central, nasal, temporal, superior and inferior. Redness and staining were graded into 0–4 level according to the Efron grading scale in the nearest 0.1 units with 0 representing normal and 4 representing the worst [21]. To reduce bias in the examiner, grading was conformed with an observation of the photographs. The average values were used for the analysis. Examinations during each visit were performed after removing the lenses and at least 2 h after waking up to reduce the overnight physiological residual effect on the ocular surface. Similarly, to minimize the effect of diurnal variation on the ocular surface changes, every visit of each subject was scheduled for the same time of day, for example, for a patient whose baseline examination was performed at 9:00–10:00, the other follow-up examinations were also conducted at the same time of day and so on [22].

Subjective comfort level was evaluated on a grading scale of 0 to 100 with 0 being the least comfortable and 100 the most comfortable [7]. Subjects were provided with a sample survey form where they should register the level of comfort just after lens insertion and at the end-of-day (just before removing out the lenses) each day. Compliance with the protocol of the study was assured and reiterated in the subsequent visit. Each month, the morning comfort (the average morning comfort score for one month) and end-of-day comfort (the average score of evening comfort for one month) were calculated. The monthly comfort level was calculated as the average of morning comfort score and the end-of-day comfort score.

Differential corneal staining, bulbar redness, limbal redness and conjunctival staining were calculated deducting the baseline values from the final values. As values in right and left eyes were not correlated ($p > 0.05$), data from both eyes were used in the analysis. Statistical Package for Social Sciences (SPSS 22) was used for the analysis of the data. Descriptive data were expressed as a mean with standard deviation (SD). The Kolmogorov-Smirnov test was applied to determine the normality of the data. Parametric tests and non-parametric tests were applied to detect the statistical relation in normally distributed and other variables respectively. Adjusted *p*-values were used in the necessary cases. The Wilcoxon signed rank test was used to

Table 1
Characteristics of the contact lenses used in the study.

	Lotrafilcon B	Comfilcon A	Balafilcon A	Stenofilcon A	Nelfilcon A	Nesofilcon A
Company	Alcon	Cooper Vision	Bausch & Lomb	Cooper Vision	Alcon	Bausch & Lomb
Brand name	AirOptix Aqua	Biofinity	Purevision2	MyDay	Dailies AquaComfort	Biotrue
Water content (%)	34	48	36	54	69	78
Thickness (mm)	0.08	0.08	0.07	0.08	0.10	0.10
Base curve/diameter (mm)	8.6/14.2	8.7/14.5	8.6/14	8.4/14.2	8.7/14	8.6/14.2
Oxygen Permeability (barrer)	110	128	91	80	26	42
Modulus (MPa)	1.2	0.75	1.1–1.25	0.4	0.89	0.49
Oxygen Transmissibility (10^{-9} (cm ml O_2)/(sec ml mmHg))	137.5	160	130	100	26	42

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