ORIGINAL ARTICLE

The Effect of Reading on Blinking Rate among Soft Contact Lens Wearers

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Abstract:

Blinking plays an important role in preservation of the corneal integrity by a proper formation of pre-corneal tear film. In contact lenses, blinking helps to keep the normal role of cornea, optical quality and hydration of contact lens surface through the interaction of tears between contact lens and cornea. This study aims to analyze the blinking rate before and while reading among soft contact lens wearers and the correlation between contact lens demographic data with dry eye symptoms before and after reading. Method: A sample of 18 subjects (17 females and one male, aged between 20-25 years) were recruited in this study. All subjects had a good ocular health and some reported mild dry eye symptoms (CLEDQ-8 score < 25). Face video recordings were captured while the subjects were looking at mark 'X' for 3 minutes at 3 meters and during reading at primary gaze position for 20 minutes at 40 cm. Texts were presented in newspaper cuttings that were compiled as a book with size N8 that consisted of 24 pages. Video analysis were conducted after each session to assess blink rate. Results: The mean blinking rate before reading was 25.70 9.54 blink/min. The blink rate while reading was 20.40 ± 9.63/min. There was no significant difference in blinking rate for 20 minutes of reading and 3 minutes before reading. There was also a poor correlation between contact lens demographic and dry eye symptoms before and while reading. Conclusion: Reading and the blinking rate were affected by soft contact lens wear. Reading newspaper cuttings with soft contact lens wear at primary gaze position influenced blinking; which interfere with the tear film dynamics. There was also a poor correlation between contact lens demographic and dry eye symptoms before and while reading. As this study recruited subjects that did not have moderate to severe dry eye, thus, it is possible to obtain these findings.

Keywords: Contact lens; Near task; Reading task; Tear film; Blinking rate; Questionnaire

1. INTRODUCTION

Blinking plays an essential role in the preservation of the corneal integrity by the proper formation of the pre-corneal tear film [1].In a lifetime, human spend the same amount of blinking as eating. Blinking involved five years with our eyes shut wherein the action is a rapid closure movement of the eyelids lasting 300-400ms [2] The existence of reflex blinking toward external stimuli is to help protect the eye from foreign particles, bright light and from injury. In other words, every blink is accompanied with a spread of oils and mucous secretions across the surface of the eyes from getting dry and cleanse them [3]. Blinking abnormalities may result in poor tear distribution, hence, cause damage to the ocular surface [4]. In contact lens wearer, blinking helps to keep the normal role of cornea, optical quality and hydration of contact lens surface through the interaction of tears between contact lens and cornea [5]. Occurrence of full blinking is during the coverage of cornea exceeding 67% by the upper lid. This action enables a healthy layer of tear film to distribute over the surface of the eye by cleansing the waste into the margin of lower tear film [6]. Blinking pattern is possibly be altered with contact lens wear since it functions as an obstruction to sensation of the lid prompting demand of reaction process that promotes to partial closing of the lid [7]. McMonnies [2] proposed that a reduction within tear film arrangement above the exterior of contact lens making the accumulation becomes much easier to precipitate on the area of interpalpebral especially on the front part of contact lens due to incomplete blinking. This state may promote the rise in proportion of tear desiccation and effects both contact lens and outer layer of cornea to dry up.

Blinking rate in soft contact lens wearers are normally caused by levels of comfort. Reflex blinking rate can change at the start prior to adjustment, as an effect of the rose in foreign body outrage experienced by the lid margins. Likewise, a poor lens fitting may also change reflex blinking [8]. The absolute value of a contact lens material link up to its inelasticity, and thus, when eye blinks, it is resistant to change shapes. A lens that has a high absolute value is not likely to follow the corneal contour during each blink. This can lead to edge grooving and inflated consciousness of the lens edge on the upper lid margin with every movement of lid. The moisture of a contact lens material is a standard of how good the material withstand rubbing Particularly, the term links to the friction level determined by the movement of lid over the lens surface with each blink, particularly if the tear film of pre-lens is deficient. Lenses with a low friction coefficient, for example, a greater moisture, can result in minimal annoyance to the upper lid while blinking and provide a smooth feeling of the lens[9].Increase in friction on the upper lid margin as it passes over a lens surface with poor wettability, specifically, a lens with heavy deposits is much liable to increase blinking rate [2]. Acknowledged that the eye flickers roughly 10,000 times a day or more, therefore, the consequence of contact lens material and subsequent lens comfort is essential [10]

Intellectual event does possess a remarkable outcome on blinking rate. Many studies have linked blink rate to cognitive load during tasks such as reading [11]. Cognitive load is a term used in cognitive psychology to illustrate the load related to the executive control of working memory. It is manipulated by increasing or decreasing information for the brain to process i.e. increased visual or audio information will lead to increased cognitive load [12]. Extensive near task such as reading found to decrease the blinking rate from a mean of 15 blinks per minute to roughly 8 blinks per minute [13]. By reading a book, tear film instability was affected and significantly caused ocular discomfort [14]. However, it is believed that blinking rate increased due to the adhesion of contact lens to the cornea and the disturbance of the tear film layer. Blinking action can be stimulated by the unstable layer of tear film over an exterior of the contact lens [15]

Hence, this study aim to compare the blinking rate before and while reading and, also to demonstrate the correlation between contact lens demographic and dry eye symptoms. Findings of this analysis could be helpful in developing understanding of blinking among contact lens wearers when performing near task such as reading and, to maintain optical quality and ocular comfort by choosing a suitable soft contact lens material.

2. MATERIALS AND METHODS

A questionnaire, Contact Lens Dry Eye Questionnaire-8 (CLDEQ-8) by Chalmers et al (2012), was utilized to acquire data in finding out the symptoms of dry eye among soft contact lens wearers. The questionnaire comprises of information regarding contact lens wearer demographics. All subjects underwent an interview about the questionnaire that was conducted prior to reading performance by using English. The research sampling method was purposive homogeneous sampling, all subjects were recruited from UiTM Vision Care. Demographic data were obtained, including gender, age, modality of contact lens, wearing schedule, wearing time, and lens material of respondents. Study was conducted with eighteen subjects wearing his or her habitual soft contact lens with and without reading performance. None of the subject had any history of ocular or systemic disease, binocular vision anomaly, or any signs of moderate to severe dry eye. Ethical approval was obtained from Institute if Research Management and Innovation of UiTM Research Ethics Committee. Blink rate with contact lens on was recorded by using a Nikon DSLR D3100 camera with resolution of 14.2 effective megapixels. Each subject was given explanation about the study and an informed consent was agreed by the participants. First, all subjects were video recorded for 3 minutes without near task (baseline measurement). At baseline measurement, subjects were asked to loosen up and focus on an "X" target placed at 3 meters. Second, subject was then asked to read a standardized newspaper cut with 1.0 line spacing with size of N8 consisting of 24 pages placed on a fixed reading stand for 20 minutes at 40 cm. All subjects were tested in the same order. The blink rate recorded was then counted by clicking a stopwatch every time a subject blinked. All reading tasks were performed under the same atmosphere lighting (1230 lux) and normal room conditions (between 23.5 ^{o} C and 25.5^{o} C) and at the same reading distance at 40 cm with the use of primary gaze position.

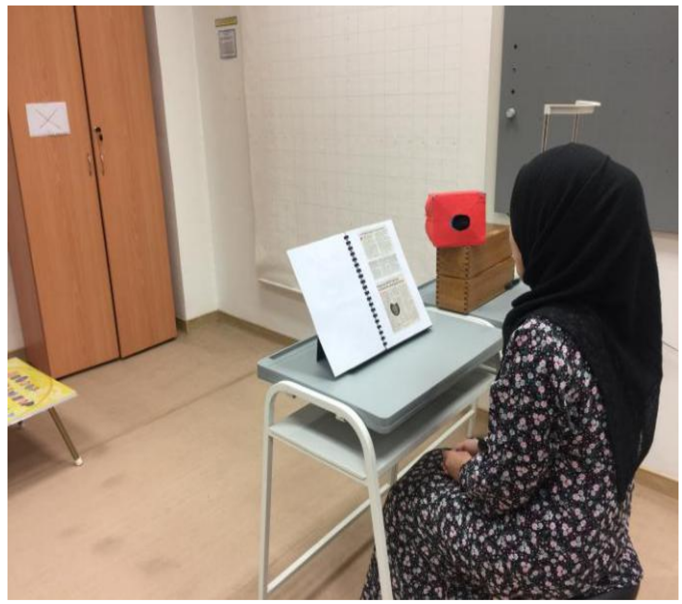

Figure 1 - Setting up of the procedure.

3. RESULTS AND DISCUSSION

3.1 Blinking rate before and after reading

The mean blinking rate before reading was 25.80 ± 9.54 blink/min. The blink rate while reading was 20.40 ± 9.63/min. There was no significant difference in blinking rate before the near task (reading) with the blinking rate while reading (p=0.024) as shown in Table 1.

Table 1: The mean blinking rate before and while reading

	Before reading Mean (SD)	**While reading Mean (SD)**	**Mean of score difference**	**T-stats (df)**	**P-value**
Blinking Rate (blink/min)	25.80 (9.54)	20.40 (9.63)	5.40 (0.808-10.00)	2.481 (17)	0.024

The spontaneous baseline measurement or the blinking rate before reading was done in 3 minutes, the mean for this rate was 25.80± (9.54) which is slightly higher than the figures declared in past studies. The spontaneous blink rate has been reported to range between 12 and 18/min [16]. This may due to the subject recruitment where the frequent blinkers were not excluded. The other reason was the time take where 15 minutes is needed to show changes in blinking rates [15]

The mean blinking rate while reading is reduced to 20.40 ± 9.63 at a primary gaze position. Many studies have disclosed that blink rate reduction is connected with basic cognitive process; the harder the task, the lesser the subject blinked. In this study, the placement of the reading material on the reading stand that is approximately 45 degrees from the eyes at a distance of 40 cm may affect the blink rate in which it is considered done at primary gaze. In contrary, study done by [17] showed that subjects blinked more when performing the tasks at primary gaze compared to when performing the tasks at down gaze. However, in another hand down-gaze position may be preferred during reading, which could in turn reduce the blink rate as down-gaze viewing decreased the eyelid aperture [16]. Down gaze position also decreased the blinking rate as the corneal exposure and less drying of ocular surface would be expected in comparison with primary gaze [13]. This could be the main reason for no immediate reduction in blink rate found in this study during performing reading task since primary gaze is applied more compared to the use of down-gaze position [18]

The mean score difference for the blinking rate before and while reading gave no significant difference (p=0.024) Argiles et.al, [13] found that the blink rate was significantly lower when reading a book. In this study, changes in the blink pattern were recorded and, then counted by using a stopwatch during 20 minutes of reading newspaper cuttings. There was no significant change in blinking rate before reading and while reading [9]. The external action on eyelid need to be considered as well, soft contact lens is strong enough to influence the rise in blink rate even in comfortable contact lens wear irrespective of any visual tasks including reading. The "unstable tear film layer over a contact lens surface may provide surface stimulation on blinking action" [19].

It is believed that increased in blink rate was due to the adhesion of contact lens to cornea and the accumulation of deposits over lens surface disrupt the tear film layer [20]. Some of the subjects in this study had reported ocular discomfort and dryness during contact lens wear. It is possible that the ocular dryness, discomfort and irritation triggered the increase of blink rate among CL wearers.

3.2 Correlation of Contact Lens Wearer and Dry Eye Symptoms

it is found that there was a poor positive correlation between contact lens wearer demographic and dry eye symptoms based on CLEQ-8 before reading and while reading as shown in Figure 2 (*r1 = +0.238*) and Figure 3 (*r2 = +0.314*) This may due to the selection of subjects as this study recruited a good patient selection where the subjects did not have moderate to severe dry eye.

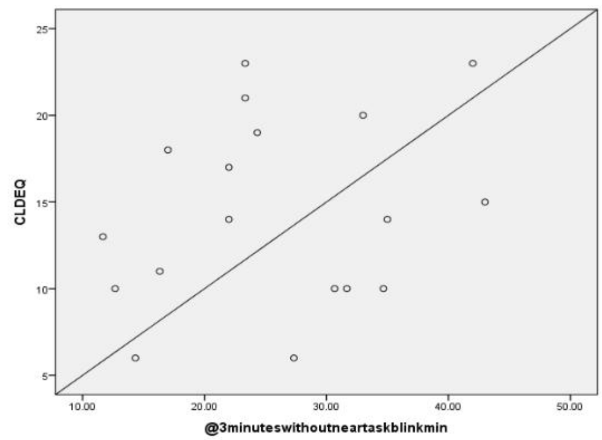

Figure 2: correlation between contact lens wearer demographic and dry eye symptoms before reading

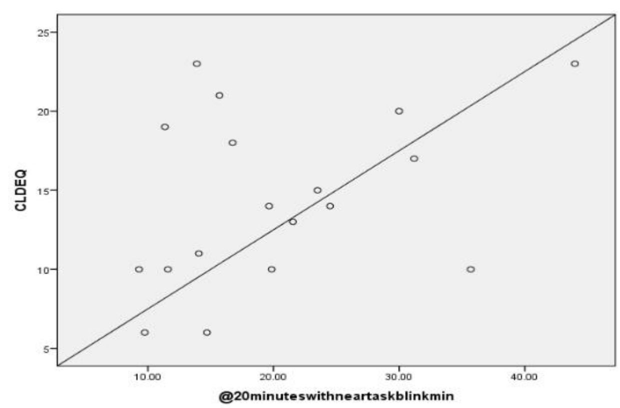

Figure 3: correlation between contact lens wearer demographic and dry eye symptoms while reading

According to a study done by Chalmers et al [21]. CLDEQ-8 is mainly to report on the development and validation a short form of dry eye questionnaire to enable it to reflect status of and change in overall opinion. Thus, CLDEQ-8 was not practical to make a stand on the mild symptoms of dry eye in some subjects

4. CONCLUSION

Reading and the blinking rate were affected by soft contact lens wear. Reading newspaper cuttings with soft contact lens wear at primary gaze position influenced blinking; which interfere with the tear film dynamics. No significant difference was found between reading and blinking rate among soft contact lens wear. There was also poor correlation between contact lens demographic and dry eye symptoms before and while reading. Limitation of this study include inter-blink was not performed with no variation on types of contact lenses, and poor correlation.

Recommendations include (1) perform inter-blink so that the result could be more accurate and precise, (2) should include toric lenses to compare differences in lens material, and (3) change to another tool such as Ocular Surface Disease Index (OSDI) or Standard Patient Evaluation of Eye Dryness (SPEED) questionnaire to evaluate dry eye disease in clinical routine. In the future, it is suggested to have a larger sample size (n>30) with prolonged reading time (>30 minutes) and, by placing the reading material on the table with the use of down-gaze position.

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