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Asymptomatic Ocular Changes among Long Term Contact Lens Users

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Abstract

The purpose of this was to determine asymptomatic adverse ocular changes among long term contact lens users. It was a cross-sectional study and convenient sampling was used to collect the sample of 100 contact lens users. This study was conducted in 4 months from 05-04-2016 to 05-08-2016 and sample was recruited from Madinah Teaching Hospital Faisalabad, E Plomer Optics and Punjab Optics Lahore. Tear film break up time (TBUT) and corneal changes were determined by using slit lamp and blink rate was recorded by direct observation and counting. SPSS version 23 was used for data analysis. Descriptive statistics was reported for variables. Results showed that 67% of contact lens users were females, 54% used soft contact lenses and 96% were myopic. Mean age of contact lens users was 30.10 ± 7.86 years. Mean daily wearing time of contact lenses was 9.82 ± 2.19 hours/day. Mean value of years of contact lens use was 8.35 ± 5.81 years. Normal range of blink rate was present in only 6 % of subjects and mean value was 26.14±6.94 blinks/minutes. 67% of subjects had abnormal TBUT and mean value was 9.14±2.89 sec. 58% of contact lens users were presented with one or more corneal changes. It was concluded that **u**n-monitored, long term use of contact lenses caused many adverse ocular changes among asymptomatic contact lens users. So regular follow-up exams are necessary for contact lens users to maintain good ocular health.

Keywords: contact lens; tear film break up time; TBUT; blink rate; corneal changes; asymptomatic; ocular changes; neovascularization; staining; abrasion; infiltrates.

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1. Introduction

A key factor in a successful contact lens wear is transmission of an adequate amount of oxygen to the eye that is required to maintain its normal metabolic activity and structural integrity. Contact lens acts as a physical barrier between the eye and atmosphere which reduces the supply of oxygen to the ocular tissues [1]. And all those factors which cause inadequate supply of oxygen to the ocular tissues lead to adverse ocular changes [2]. These changes are usually asymptomatic at initial stages and difficult to detect early, but can cause vision threatening conditions if remain unmonitored [3]. The physical placement of a contact lens over the ocular surface divides the tear film into two parts, i.e. a pre-lens tear film and a post-lens tear film and it forms a new interface within the ocular atmosphere. This division and new interface induce changes in stability of tear film [4]. The blinking influenced by comfort levels, corneal sensitivity and dryness symptoms. It is mediated by the tear film disruption that is sensed by the corneal nerve fibers, and increased blinking acts to refresh the tear film to relieve dryness symptoms. Contact lens users report higher ratings of dryness and hence have an increased blink rate [5]. Contact lens's materials reduces the transmission of oxygen to the cornea which results in corneal neovascularization [6]. In contact lens wear due to hypoxic conditions, changes in the corneal metabolism cause inflammation and the aggregation of these white blood cells called infiltrates [7]. Corneal staining is also related to contact lens wear, type of contact lens care solutions, disinfectants, daily wearing time, materials and deposits are associated with corneal staining [8]. These effects are numerous and usually asymptomatic at initial stages and range from mild to severe in their impact on the cornea [3]. The aim of this study was to identify the adverse ocular changes among asymptomatic contact lens users and highlight these changes in community to set standards at national level for contact lens user's care, proper examination and regular follow up.

2. Materials and Methods

It was an observational, cross-sectional study and convenient sampling technique was used to collect the sample of 100 contact lens users. The study was conducted in 4 months from 05-04-2016 to 05-08-2016 and sample was recruited from Madinah Teaching Hospital Faisalabad, E Plomer Optics and Punjab Optics Lahore. For ethical concerns, approval of study obtained from the ethical review board of The University of Faisalabad in accordance with the principles of Declaration of Helsinki. Subjects aged 15 to 55 years, those used contact lenses for more than 1 year and without any complain / symptom related to contact lens use were included in the study. Subjects suffering from any disease of cornea or conjunctiva, had complain / symptoms related to contact lens wear and those used contact lenses for less than 1 year were excluded from study. An informed consent form delivered to gain consent from participants for their voluntary participation by briefly describing the study topic, its purpose, duration and assuring for confidentiality of respondents personal information. Subject's demographic details were recorded in specially designed self-structured Performa. Firstly a gross slit lamp examination was performed in a consistent, orderly fashion from eyelid to cornea by using diffuse illumination slit lamp technique. Due to unavailability of multiple instruments required to observe all ocular changes, this study observed blink rate, tear break up time and only few most frequent corneal changes (neovascularization, infiltrates, staining and abrasions). To observe corneal changes slit lamp direct observation techniques (optic section and parallelepiped) were used. To measure tear film break-up time (TBUT), the subject was asked to look upward and sodium fluorescein was applied to the sclera at lower fornix by using fluorescein strip

moistened by normal saline and then subject was asked to blink several times. After that subject was instructed to avoid blinking and the tear film was observed between blinks with a slit lamp under cobalt blue light and time noted between a complete blink and the appearance of the first black dry spot. Then subjects were asked to relax him/her by sitting comfortably and looking outside window and the blink rate (numbers of blinks per minute) was determined by direct observation, counting and using a stop watch. SPSS version 23 was used for data analysis. Descriptive statistics (mean, median, mode, standard deviation, range) were generated and reported for variables.

3. Results

3.1. Gender Wise Distribution of Contact Lens Users

A sample of 100 contact lens users was recruited in the study in which female contact lens users were 67 (67%) and male contact lens users were 33 (33 %).

3.2. Age Wise Distribution of Contact Lens Users

The age of contact lens users found in this study was ranged from 16 to 55 years with mean age of 30.10 ± 7.86 years. The mean age of male contact lens users was 28.45 ± 4.96 years and of female contact lens users was 30.91±8.87 years. The contact lens users were distributed into different age groups and it was found that higher proportion of contact lens users was present in age group 25 – 29 years (29%), followed by age group 20 – 24 years (21%), 30 – 34 years (17%) and 35 – 39 (15%).

3.3. Occupation Wise Distribution of Contact Lens Users

The contact lens users included in this study belonged to different occupations. It was found that majority of contact lens users were students (28%) followed by computer operators (16%), lecturers (13%) and house wives (13%).

3.4. Types of Contact Lenses

The study subjects were found wearing different types of contact lenses. 54% of subjects were soft contact lenses users, 17% were soft cosmetic contact lens users, 14% were RGP contact lenses users, 12% were soft toric contact lens users and 3% were silicone hydrogel contact lens users.

3.5. Daily Wearing Time (DWT) of Contact Lenses

The daily wearing time of contact lens determined in this study ranged from 4 to 16 hours/day and mean value was 9.82 ± 2.19 hours/day. Mean daily wearing time in males was 10.79±1.77 hours/day and in females was 9.34±2.21 hours/day. It was found that maximum proportion (60%) of contact lens users were wearing contact lenses for 9 – 12 hour/day followed by 35% wearing contact lenses for 4 – 8 hours and remaining 5 % wearing contact lenses for 13 – 16 hours.

3.6. Years of Contact Lens Use

The years of contact lens use found in this study was ranged from 1.5 to 30 years with a mean value of 8.35 ± 5.81 years. Mean value of years of contact lens use in males was 7.90±3.77 years, and in females was 8.85±6.60 years. 39% of subjects used contact lenses from 1 to 5 years, followed by 37% for 6 to 10 years, 12% for 11 to 15 years and 7% for 16 – 20 years.

3.7 Contact Lens Powers

In this study very high proportion of contact lens users was myopic (96 %) and used contact lenses of minus power. Minus power of contact lens ranged from -0.50 to -17.00D with a mean value of -4.46 D ±3.69 D. Proportion of hyperopic contact lens users was only 4 % and plus power of contact lenses was ranged from +2.00 to +5.00D with a mean value of +4.00D ±1.35 D.

3.8. Blink Rate Among Contact Lens Users

This study found an increased blink rate among majority of contact lens users and it was ranged from 12 to 40 blinks/minutes with a mean value of 26.14±6.94 blinks/minutes. It was found that blink rate was higher in males with mean value of 27.73±7.05 blinks/minutes than in females with mean value 25.36±6.808 blinks/minutes. Results determined that normal range of blink rate (11-15 blinks/minute) was present in only 6 % of contact lens users (Table 1).

Table 1: Blink rate among contact lens users

Blink Rate (blinks/Minute)	Frequency			Percent	Cumulative Percent
	Male	Female	Total		
Normal (11-15)	1	5	6	6.0	6.0
Mild Increase (16-20)	5	18	23	23.0	39.0
Moderate Increase (21-30)	16	31	47	47.0	76.0
Higher Increase(Greater Than 30)	11	13	24	24.0	100.0
Total	33	67	100	100.0	
Mean: 26.14 blinks/minute Median: 25.00 blinks/minute Mode: 25 blinks/minute Std. Deviation: 6.94 blinks/minute Range: 12 to 40 blinks/minute					

It was determined that in 94% of contact lens users, blink rate was greater than 15 blink/minute, in 71% of contact lens users, blink rate was greater than 20 blinks/minute and in 48% of contact lens users blink rate was greater than 25 blinks/minute (Table 2).

3.9. Tear film break-up time (TBUT) Among Contact Lens Users

A decreased value of TBUT was found in majority of contact lens users. TBUT value was ranging from 4 to 18 sec with a mean value of 9.14±2.89 sec. In males average TBUT was 8.88 ± 2.50 sec and in female it was 9.27±3.08 sec. The results determined that 67% of contact lens users had abnormal TBUT (Table 3).

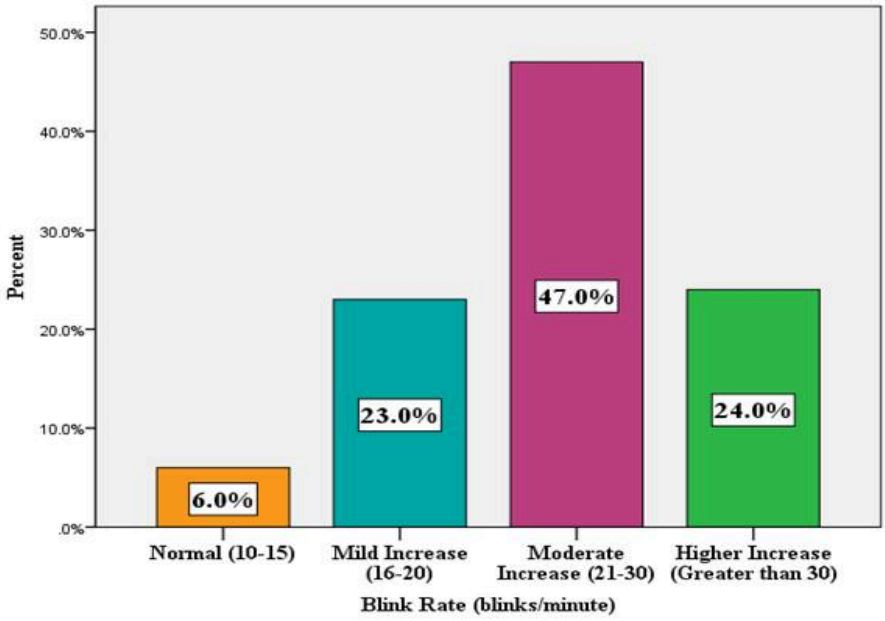

Figure 1: Blink Rate among Contact Lens Users. It showed that most of contact lens users had blink rate ranged between 21 – 30 blinks/minutes.

Table 2: Distribution of contact lens users into different ranges of blink rate

Blink Rate (blinks/Minute)	Frequency			Percent	Cumulative Percent
	Male	Female	Total		
11-15	1	5	6	6.0	6.0
16-20	5	18	23	23.0	29.0
21-25	9	14	23	23.0	52.0
26-30	8	17	25	25.0	77.0
31-35	6	9	15	15.0	92.0
36-40	4	4	8	8.0	100.0
Total	33	67	100	100	

Table 3: TBUT among contact lens users

TBUT Ranges (sec)	Frequency			Percent	Cumulative Percent
	Male	Female	Total		
Abnormal (≤ 10)	23	44	67	67	67.0
Normal (> Than 10)	10	23	33	33	100.0
Total	33	67	100	100.0	
Mean: 9.14 sec Median: 9.00 sec Mode: 8 sec Std. Deviation: 2.89 sec Range: 4 to 18 sec					

It was determined that higher frequency (56%) of contact lens users had TBUT value ranged from 6 – 10 sec and 11% had TBUT value less than 5 sec (Table 4).

Table 4: Distribution of contact lens users into different ranges of TBUT

TBUT Ranges (sec)	Frequency			Percent	Cumulative Percent
	Male	Female	Total		
1-5	3	8	11	11.0	11.0
6-10	20	36	56	56.0	67.0
11-15	10	21	31	31.0	98.0
16-20	0	2	2	2.0	100.0
Total	33	67	100	100.0	

3.10. Corneal Changes among Contact Lens Users

Various corneal changes among contact lens users were observed in this study. Results showed that 58% of contact lens users were presented with one or more corneal changes while 42% of contact lens users had no corneal change**.** Some contact lens users were presented with 2 or more corneal changes at a time. It was found that 34% contact lens users had only one, 17% had 2, 5% had 3, and 2% had 4 corneal changes at a time (Table 5).

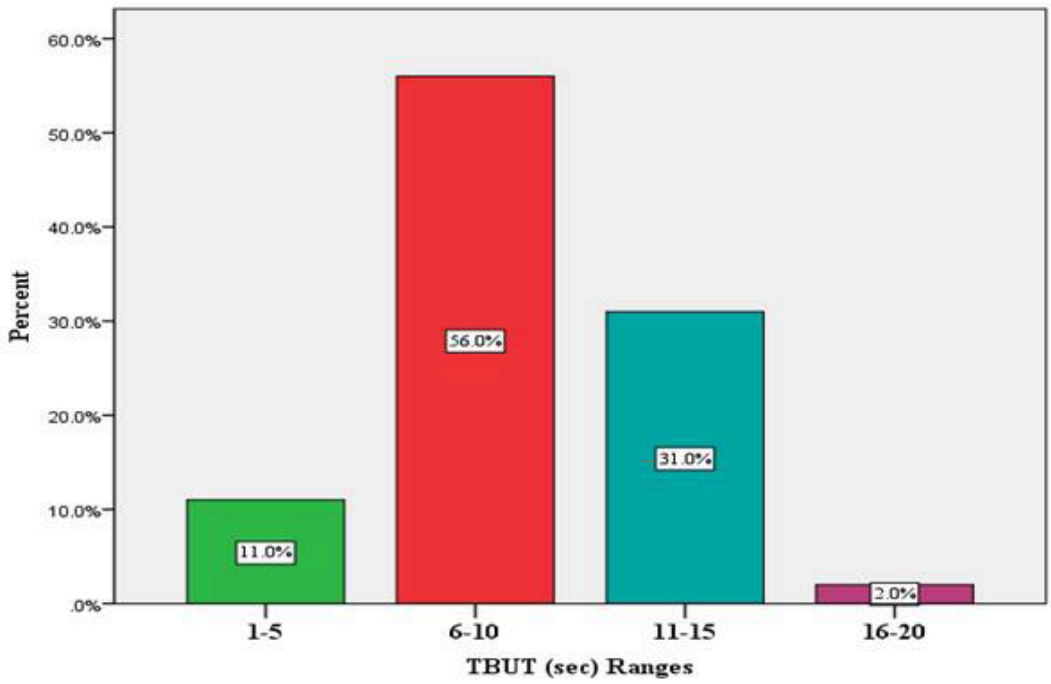

Figure 2: TBUT among contact lens users. It showed that most of contact lens users had TBUT ranged 6 – 10 sec.

Table 5: Corneal Changes among Contact Lens Users

Corneal Changes	Frequency			Percent	Cumulative Percent
	Male	Female	Total		
None	10	32	42	42.0	42.0
Neovascularization	5	12	17	17.0	59.0
Infiltrates	2	3	5	5.0	64.0
Staining	2	6	8	8.0	72.0
Abrasion	3	1	4	4.0	76.0
Neovascularization + Infiltrates	0	2	2	2.0	78.0
Neovascularization + Staining	3	6	9	9.0	87.0
Neovascularization + Abrasion	0	1	1	1.0	88.0
Infiltrates + Staining	2	0	2	2.0	90.0
Staining + Abrasion	3	0	3	3.0	93.0
Neovascularization + Infiltrates + Staining	2	2	4	4.0	97.0
Infiltrates + Staining + Abrasion	0	1	1	1.0	98.0
All	1	1	2	2.0	100.0
Total	33	67	100	100.0	

It was determined that out of 58% of corneal changes, neovascularization was 38% followed by corneal staining 33%, corneal infiltrates 17% and corneal abrasions 12% (Table 6).

Table 6: Distribution of contact lens users into 4 main categories of corneal changes

Corneal Changes	Frequency	Percent	Cumulative Percent
Neovascularization	35	38.0	38.0
Staining	29	33.0	71.0
Infiltrates	15	17.0	88.0
Abrasion	11	12.0	100.0
Total	90	100.0	

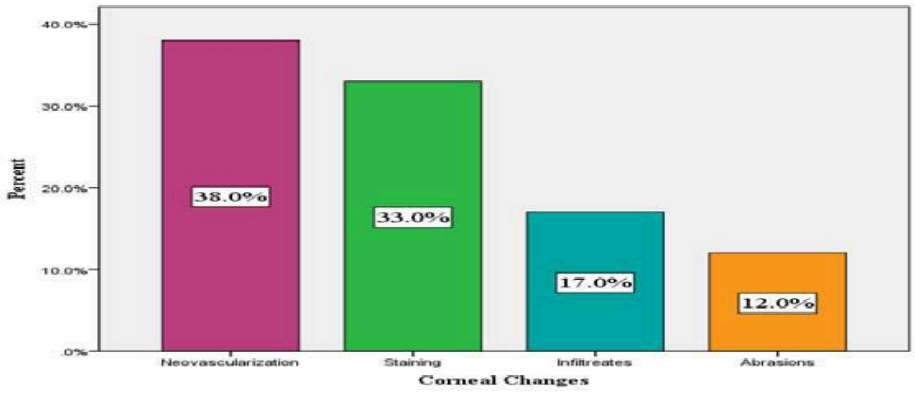

Figure 3: Corneal changes among contact lens users. It showed that corneal neovascularization was most common adverse corneal change among contact lens users.

4. Discussion

The ratio of female contact lens users was high in this study and similar ratio found in Nichols and Sinnott [8], Martín-Montañez and his colleagues [5], Nichols and Sinnott [8] and Pili and his colleagues [10] studies. But these findings were against to the findings of Kastelan and his colleagues [11] study in which proportion of male contact lens users was high than females.

The age of contact lens users found in this study was ranged from 16 to 55 years with mean age of 30.10 ± 7.86years. These results were in line with those reported by Martín-Montañez and his colleagues [5], Nichols and Sinnott [8], Nichols and Sinnott [9] and Roshani [12] studies.

In this study 54% of subjects were soft contact lenses users. The proportion of soft contact lens users was also shown high by Nichols and Sinnott [8] and Nichols and Sinnott [9] studies and that might be because soft contact lenses were prescribed for the most of refractive errors and also used for cosmetic purposes. Furthermore, soft contact lenses could provide more comfortable wear, better fitting and were easily available from optical shops in different powers and colors.

The daily wearing time of contact lens determined in this study ranged from 4 to 16 hours/day and mean value

was 9.82 ± 2.19 hours/day. Similar results were reported by Pili and his colleagues [10] and Kastelan and his colleagues [11] studies. The reason might be that in various offices, institutions and colleges, duty and study timings were 8 to 12 hours a day during which the subjects needed to use their contact lenses to perform their routine work.

The years of contact lens use found in this study was ranged from 1.5 to 30 years with a mean value of 8.35 ± 5.81 years. These results were in line with those reported by Nichols and Sinnott [9] and Martín-Montañez and his colleagues [5] studies. This might be because the use of contact lenses being a recent trend that was increasing rapidly from last decade therefore most of subjects used contact lenses for less than 10 years. In contrast longer period of contact lens use was found in Nichols and Sinnott [8] study that might be due to the regional difference as the people in developed countries might have earlier awareness about contact lenses use.

In this study very high proportion of contact lens users were myopic (96 %). Most probably this might be because myopia was the most common refractive error of adult age and therefore majority of contact lens users were wearing minus power contact lenses. No other study was found to sufficiently discuss the results.

In this study only 4 % of contact lens users were hyperopic. This might be because hyperopia was not common in adult age therefore subjects used plus power of contact lenses were also less. No other study was found to sufficiently discuss the results.

This study found an increased blink rate among contact lens users. The reason might be that decreased tear film stability among contact lens users induced an increase in blink rate to refresh the tear film at short intervals. The results of this study were in favor with the studies of Craig and his colleagues [4], Martín-Montañez and his colleagues [5], Roshani [12], Jansen and his colleagues [13] and Gupta and his colleagues [14] studies. But these findings were contrary to Van Der and his colleagues [15] findings those reported that overall blink frequency remained same among RGP contact lens users.

A decreased value of TBUT was found in majority of contact lens users. The reason might be that the contact lens induced hypoxia interfered with tear film stability and resulted in shortened TBUT. These results were similar to Craig and his colleagues [4], Nichols and Sinnot [9], Pili and his colleagues [10], Kastelan and his colleagues [11], Jansen and his colleagues [13], Gupta and his colleagues [14], Du Toit and his colleagues [16], Thai and his colleagues [17], Glasson and his colleagues 18], Riley and his colleagues [19], Stapleton and his colleagues [20], Janine and his colleagues [21], Guillon and Maissa [22], Young and his colleagues [23] and Sweeney and his colleagues [24] studies. However these findings were contrary to the results reported by Santodomingo-Rubido and his colleagues [25] study. This could be due to the regional, racial or environmental differences.

Various corneal changes among contact lens users were observed in this study. This reason might be that the long term contact lens wear induced hypoxia and dryness in the eye which lead to corneal changes. These results were in line with those reported by Liesegang [26], Efron and his colleagues [27] and Beljan and his colleagues [28] studies. The study results showed that neovascularization was a most common contact lens

induced corneal change and these results were in agreement with those reported by Liesegang, [26] Beljan and his colleagues [28], Wong and his colleagues [29], Kymionis and Kontadakis [30] and Lee and his colleagues [31] studies. This study determined that corneal staining was also very common among contact lens users and these finding were similar to the Nichols and Sinnott [9], Pili and his colleagues [10], Kastelan and his colleagues [11], Du Toit and his colleagues [16], Riley and his colleagues [19], Santodomingo-Rubido and his colleagues [25], Beljan and his colleagues [28], Efron and his colleagues [27] and Nichols and his colleagues [32] studies. The findings of this study regarding contact lens induced corneal infiltrates were found to be in line with the findings of Efron and his colleagues [27], Beljan and his colleagues [28] and Muntz and his colleagues [33] studies. This study also determined corneal abrasions among contact lens users and these results were in favor with those found in Efron and his colleagues [27] and Beljan and his colleagues [28] studies.

5. Conclusions

It was found that long term use of contact lenses caused many adverse ocular changes among contact lens users and it was highlighted that the ocular changes observed in this study were asymptomatic and subjects were totally unaware about them. So it is concluded that if contact lens wear remained un-monitored for long time it could lead to various adverse ocular events without causing any problem at initial stages. In this study long term use of contact lenses increased the blink rate, decreased the TBUT and induced the corneal changes (neovascularization, staining, infiltrates, abrasions) among asymptomatic contact lens users. This study suggests that the best way to prevent eye damage and sight loss is only by using the suitable contact lens as prescribed by the eye care professional and following proper lens care guidelines. Therefore an initial complete eye examination and regular follow-ups are very necessary to examine the ocular health or any adverse effects if caused by contact lens wear.

6. Recommendations

- It is recommended that contact lenses should be prescribed only by ophthalmologists, optometrists and licensed contact lens practitioners and it should be banned to sell contact lens without prescription.
- A complete and thorough ocular examination should be required before contact lens prescription, to rule out the suitability of subject for contact lens wear and regular follow-up should be necessary to avoid complications related to contact lens and practitioner should illustrate the importance of regular follow up to subjects.
- Proper guidance and instructions should be given to all subjects about contact lens handling and care at the time of purchase and subjects should be warned against harmful effects of contact lenses if mishandled.

7. Limitations

- Contact lens wear causes various changes in the eye. But this study could not measure all the ocular changes due to unavailability of multiple instruments required to observe all ocular changes.

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