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DRY EYE IN CONTACT LENS WEARERS AS A GROWING PUBLIC HEALTH PROBLEM

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SUMMARY

Background: *The aim of this study is to analyze the relationship between the self-reported symptoms and objective signs of dry eye disease in long-term rigid gas-permeable (RGP) or soft contact lens (SCL) wearers.*

Subjects and methods: *The study included 84 eyes of Caucasian RGP and SCL wearers between the age of 15 and 71 who wore contact lenses on a continuous daily basis for more than 1 year. Symptoms were assessed according to the Ocular Surface Disease Index (OSDI). Clinical assessments included corneal fluorescein staining according to the National Eye Institute (NEI) staining grid and tear film break-up time (TBUT).*

Results: *There were more female (76.19%) than male (23.81%) persons with a higher proportion of RGP wearers among the females (88.89% vs. 11.11%). The mean duration of daily lens wear was 7.71±2.72 hours. No RGP wearer in this study had a NEI corneal staining grid score higher than 2. A weak negative correlation was found between daily lens wear duration and TBUT (Pearson's coefficient, r=-0.1467). A strong negative correlation was found between TBUT and OSDI values (r=-0.844).*

Conclusion: *The results of the study emphasize the importance of early and accurate diagnosis of dry eye disease for successful long term RGP and SCL contact lens wear. This will hopefully motivate future larger scale investigations on dry eye related problems in contact lens wearers.*

Key words: *dry eye - soft contact lens - rigid gas-permeable contact lens - Ocular Surface Disease Index (OSDI) - tear film break-up time (TBUT)*

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INTRODUCTION

Dry eye syndrome is recognized as a growing public health problem and one of the most frequent reasons for seeking ophthalmological intervention (Kaštelan et al.2013a, Kaštelan et al 2013b, Behrens at al 2006). Dry eyes, redness and foreign body sensation are common complaints among contacts lens wearers (Kaštelan et al. 2013a) with these symptoms being more prevalent in contact lens wearers than in the general population (Nichols et al. 2005). Due to changes associated with dry eye these persons also often complain of visual impairment and blurred vision (Tutt et al. 2000). The mentioned symptoms and disturbances appear to be more common in the evening than during the day (Begley et al. 2000).

Previously conducted investigations estimate that the frequency of contact lens related dry eye is approximately 50% (Nichols et al. 2005, Tutt et al. 2000, Guillon et al. 1997). Besides blurred vision dry eye symptoms in contact lens wearers is also associated with reductions in daily wearing time and an increased risk of ocular surface dryness and infection (Young et al. 2004, Ladage et al. 2001). Discomfort and desiccation symptoms are the primary reasons for contact lens intolerance, a reduction in the length of wearing time and eventual discontinuation (Richdale et al. 2001). In a study conducted to investigate the reasons for cessation of wearing contact lenses 51% of the participants reported discomfort as the main reason (Young et al. 2002). It has been suggested that potential pathogenesis of contact lens-related dry eye include tear hyperevaporation, inflammation of the ocular surface, reduced capability of tear glands to produce tears of optimal composition with concurrent increased osmolarity, hormonal changes and disturbances, dryness related to lack of biocompatibility of the lens surface or any combination of these mechanisms (Kaštelan et al. 2013a, McMahon et al. 2000, Lemp et al. 1995, Gilbard et al. 1986, Gotovac et al. 2013, Nichols & Sinnott 2006). The diagnosis of dry eye is set on the basis of self-reporting of symptoms and clinical examinations (Kaštelan et al. 2013a). The examinations usually include the tear break up time test (TBUT) as an indicator of tear film stability, the Schirmer test which measures the tear production as well as corneal and conjunctival staining for assessment of ocular surface epithelial damage (O'Brien & Collum 2004). However, the correlation between the dry eye subjective symptoms severity and clinical dry eye tests are frequently inconsistent (Lemp et al. 1995, O'Brien & Collum 2004). To facilitate the diagnosis several patient-reported outcome (PRO) questionnaires are available so as to give useful information which can aid in the identification and assessment of the severity of dry eye disease symptoms (Kaštelan et al. 2013a). The Ocular Surface Disease Index (OSDI) is one of the most commonly used PRO questionnaires and includes the three segments namely ocular symptoms, vision-related function and environmental triggers (Walt 2004).

It is known that long-term contact lens wear may decrease corneal thickness and increase the corneal curvature with surface irregularity (Pflugfelder et al. 2002). However, despite a significant change in materials and designs of RGP lenses in the last 20 years and a significant number of RGP fits in some Western countries, there is still a lack of evidence regarding differences in dry eye symptoms and signs between long term RGP and soft contact lenses wearers (Efron et al. 2012).

The aim of this report is to analyze the relationship between the subjective self-reported symptoms and objective signs of dry eye disease in patients who wear rigid gas-permeable (RGP) or soft contact lenses (SCL) (Kaštelan et al. 2013a).

SUBJECTS AND METHODS

Subjects

The study included 42 Caucasian (84 eyes) daily long-term wearers of rigid gas-permeable and soft contact lens between the ages of 15 and 71 with the prerequisite being that they wear contact lenses on daily basis continuously for more than 1 year. Patients being treated for ocular infection within 4 weeks, those who used artificial tear preparations within one week, had a history of refractive and other corneal surgeries or presented with eyelid anomalies were excluded from the study. The lens materials varied in their oxygen permeability (Dk) values. The Dk value of RGP lenses worn by participants was between 28 and 100 Dk whereas the soft lens materials had Dk values between 9 and 110.

Methods

Symptoms of ocular dryness were assessed using the Ocular Surface Disease Index (OSDI). The OSDI scores were calculated according to the formula recommended by Schiffman et al. (Schiffman et al. 2000). The Ocular Surface Disease Index (OSDI), developed by the Outcomes Research Group at Allergan Inc., is a reliable 12-question survey designed to measure the severity of dry eye symptoms and evaluate how they affect vision-related functioning. This instrument elicits responses on three subscales: vision-related function (watching TV, reading), ocular symptoms (grittiness, blurred vision) and environmental triggers (low humidity, high wind). In addition to effectively discriminating among normal, mild to moderate and severe dry eye disease with good to excellent reliability. OSDI results are quantitative and suitable for statistical analysis. The Ocular Surface Disease Index (OSDI) rates dry eye severity on a scale of 0 to 100. For each question, patients choose a number between 0 and 4 to describe their symptoms, where 0 indicates none of the time, 1 some of the time, 2 half of the time, 3 most of the time and 4 all the time. If a patient chooses 2 for all the questions, his OSDI score would be 50. The lower a patient's score, the fewer dry eye symptoms and vice versa.

The additional questionnaire included data on average daily contact lens wear time and systemic and/or local therapy. Clinical assessments included corneal fluorescein staining and tear film break-up time (TBUT).

Corneal staining was graded using the National Eye Institute (NEI) staining grid in which a score of 0-3 (0 - normal and 3 - severe) was assigned to each of five corneal regions (central, nasal, temporal, superior and inferior) with a maximum total score of 15. Patients were divided in two groups depending on the corneal staining score for each eye with a grade <2 in either zone representing the threshold for a normal finding.

Statistical analysis

Statistical data analysis was based on inferential statistics performed with commercially available software (SPSS ver. 10.0 for Windows). Our goal was to estimate the difference in population proportions and determine the correlation between tested variables by using the Pearson's correlation coefficient (r). As the tested variables had no functional relationship, correlation analysis was used to determine the strength of the statistical or stochastic relationships.

RESULTS

Table 1 presents the structures of the participants according to gender, age, daily lens wear. The results are shown for the entire group and in relation to three levels of OSDI (Ocular Surface Disease Index) values. There were more females (76.19%) than male (23.81%) patients, with 83.33% of them having moderate OSDI score. A mild OSDI score had 71.43% female participants, which is less than expected regarding the proportion of females in the whole sample (76.19%). There were fewer males than expected regarding the sample with a moderate OSDI score (16.67%). More males compared to the total share (23.81%) of males in the sample have a mild score (28.57%). The mean age of all contact lens wearers was 36.86±16.31 years with a range from 15 to 71 years of age and median value being 36.5 years. The patients wore their lenses from 1 to 31 years prior to presentation (11.64±7.88 years). Daily lens wear duration was from 4 to 13 hours with an average of 7.71±2.72. From the total number of respondents 50% wore daily lenses less than or equal to eight hours and the remaining 50% of the respondents wore them for 8 hours and longer. The age structure shows that the largest proportion of the participants were younger than 30 years of age namely 47.62%. It was noted that normal OSDI score related to age had a similar structure. In the moderate OSDI score level the participants at the age up to 30 have a smaller proportion (33.33%) than expected according to the results at the sample level (47.62%). The age group from 30 to 50 years of age accounts for a significantly larger part (50%) for the moderate OSDI scores level compared to the share of this age group in the actual sample (30.95%).

Table 1. The relative frequency of normal, mild and moderate OSDI scores according to gender, age, duration of daily lens wear and TBUT

		Total N (%)	OSDI Normal N (%)	OSDI Mild N (%)	OSDI Moderate N (%)
Gender	Male	20 (23.81)	6 (20.00)	12 (28.57)	2 (16.67)
	Female	64 (76.19)	24 (80.00)	30 (71.43)	10 (83.33)
	Total	84 (100)	30 (100)	42 (100)	12 (100)
Age (years)	15-30	40 (47.62)	14 (46.67)	22 (52.38)	4 (33.33)
	30-50	26 (30.95)	10 (33.33)	10 (23.81)	6 (50.00)
	50-70	18 (21.43)	6 (20.00)	10 (23.81)	2 (16.67)
	Total	84 (100)	30 (100)	44 (100)	12 (100)
Daily lens wear Duration (hours)	≤8	48 (57.14)	18 (60.00)	24 (57.14)	6 (50.00)
	>8	36 (42.86)	12 (40.00)	18 (42.86)	6 (50.00)
	Total	84 (100)	30 (100)	42 (100)	12 (100)
TBUT*	Pathological	38 (45.24)	6 (20.00)	20 (47.62)	12 (100.00)
	Normal	46 (54.76)	24 (80.00)	22 (52.38)	0 (0)
	Total	84 (100)	30 (100)	42 (100)	100 (100)

*p<0.01 (Chi-squared test of independence confirmed the dependence of variables TBUT and OSDI with 1% significance); OSDI - Ocular Surface Disease Index; TBUT - Tear Break-up Time

Table 2. The relative frequency of soft and rigid gas-permeable wearers according to gender, age, duration of daily lens wear, TBUT and OSDI

		Lens type SCL N (%)	Lens type RGP N (%)	Total N (%)
Gender	Male	18 (27.27)	2 (11.11)	20 (23.81)
	Female	48 (72.73)	16 (88.89)	64 (76.19)
	Total	66 (100)	18 (100)	84 (100)
Age (years)	15-30	34 (54.55)	4 (22.22)	38 (47.62)
	30-50	20 (27.27)	8 (44.44)	28 (30.95)
	50-70	12 (18.18)	6 (33.33)	18 (21.43)
	Total	66 (100)	18 (100)	84 (100)
Daily lens wear Duration (hours)	≤8	44 (66.67)	4 (22.22)	48 (57.14)
	>8	22 (33.33)	14 (77.78)	36 (42.86)
	Total	66 (100)	18 (100)	84 (100)
TBUT	Pathological	28 (42.42)	10 (55.56)	38 (45.24)
	Normal	38 (57.58)	8 (44.44)	46 (54.76)
	Total	66 (100)	18 (100)	84 (100)
OSDI	Normal	22 (33.33)	8 (44.44)	30 (35.71)
	Mild	36 (54.55)	6 (33.33)	42 (50.00)
	Moderate	8 (12.12)	4 (22.22)	12 (14.29)
	Total	66 (100)	18 (100)	84 (100)

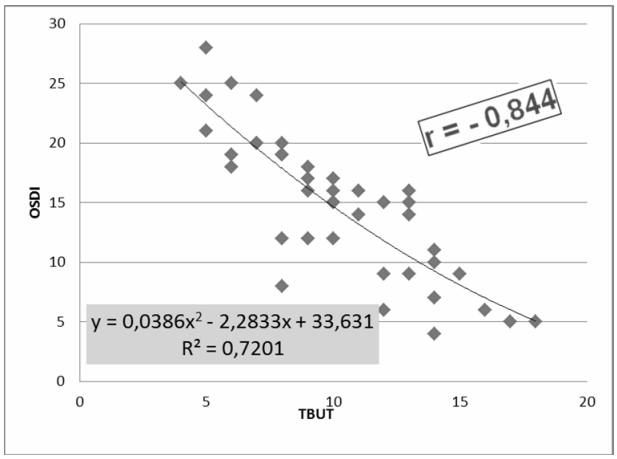
TBUT - Tear Break-up Time; OSDI - Ocular Surface Disease Index; SCL - Soft Contact Lens; RGP - Rigid Gas-Permeable

The structure of the participants was analyzed according to gender, age, hours of daily lens wear and the TBUT value, separately for SCLs and RGPs wearers (Table 2). Regarding age, the ratio between males and females was 27.27% as opposed to 72.73% for SCL wearers and 11.11% of males and 88.89% females in RGP contact lens wearers. The participants included in the study according to their age were divided into classes up to 30 years, between 30 and 50 and from 50 to 70 years of age and older. The majority of the respondents wearing SCLs were younger than 30, whereas those wearing RGPs accounted for 22.22% which is significantly less than the share in the sample (47.62%). The participants older than 30 years of age to a larger extent opted for RGPs. The mean duration of daily lens wear was 7.71±2.72 hours, with a significantly higher proportion of patients who wore their lenses for prolonged hours in the soft contact lens group ($p<0.05$). No RGP wearer in this study had a NEI corneal staining grid score higher than 2.

The number of daily hours of wearing contact lenses in the whole sample size has been distributed as follows: 57.14% wearing lenses less or equal to 8 hours. Further, regarding SCLs wearers there are as many as

66.67% who wear them for less or equal to eight hours daily. Alternatively in the group of RGPs users there are only 22.22% who wear lenses less or equal to eight hours daily with the majority wearing them for more than eight hours daily. The TBUT values have been divided into two groups: the pathological and the normal. In SCL wearers 42.42% have a pathological level of TBUT. For the RGP users the situation is more favorable with 30% of them having a pathological TBUT level. In the whole sample there were 45.24% of participants with pathological TBUT levels.

Figure 1 presents a scatter diagram of the correlation and regression of TBUT and OSDI showing a statistically significant negative correlation of TBUT and OSDI scores with Pearson's correlation coefficient r=-0.844.



p<0.01, OSDI - Ocular Surface Disease Index, TBUT - Tear Break-up Time

Figure 1. Scatter diagram of the correlation and regression of TBUT and OSDI

DISCUSSION

Dry eye is a multifactorial disease of the tears and ocular surface with symptoms that often fail to correspond to diagnostic testing (Kaštelan et al. 2013b). It is a widespread problem that may often be overlooked since it is not a common cause of permanent visual morbidity (Schaumberg et al. 2002, Latkany 2008). However, newer concepts suggest that dry eye syndrome can have a significant impact on visual function diminishing the everyday quality of live (Goto et al. 2002). Left untreated, the wearer may experience not only discomfort and visual disturbances but also ocular inflammation and scarring of the corneal surface and permanent damage (Latkany 2008, Goto et al. 2002). Management of ocular surface disorders requires thorough history and ophthalmological examination. The incorporation of a questionnaire may facilitate the evaluation of patients and aid in setting a diagnosis. A variety of treatment modalities are currently available and the selection of treatment can be simplified by classifying symptoms on a continuum from mild to severe and thereby choosing therapies that target the underlying inflammatory process with the goal of restoring the normal tear film and function (Kaštelan et al. 2013b). To overcome these issues, practitioners need to know how to evaluate dry eye symptoms and offer the best lens materials and care solutions in order to relieve patient's discomfort. This study suggests that OSDI scores may be useful for assessing dry-eye related discomfort in contact lens wearers. When used as an adjunct to objective TBUT testing, subjective OSDI scores may help practitioners evaluate the severity and identify possible causes of dry eye symptoms and at the same time testing regimen can help evaluate ocular changes associated with contact lens materials and care solutions.

Contact lens wear compromises the precorneal film stability and causes the disappearance of the lipid layer in the post-lens fraction which is responsible for the tear film stability. Furthermore this separation of tear film triggers an increase of water evaporation (Doughty 1999) followed by a corresponding increase of the tear osmolarity and consequently resulting in ocular surface damage (Gilbard et al. 1986, Stahl et al. 2012, Foulks 2007). During long time wearing of contacts these changes may become more pronounced and the effect of contact lens precorneal position is accumulated over time which manifests as a stronger feeling of discomfort consequently meaning a higher OSDI score (Kaštelan et al. 2013b). It is hypothesized that mechanisms other than tear film separation, such as changes in corneal epithelium and/or cytokine production, may also contribute to the poorer TBUT and OSDI values in long term wearers. Furthermore we should be aware that there is an increasing number of contact lens wearers being treated due to glaucoma with additional negative influence on tear film stability (Salopek-Rabatić et al 2013, Tomić et al. 2013, Kaštelan et al. 2013c).

Our investigation was conducted as a pilot study with a smaller number of participants. Nevertheless, motivating results were obtained particularly considering the small number of publications addressing the differences in symptoms and signs of dry eye in RGP and soft lens wearers in the last few decades. We hope that this study will encourage researchers to conduct larger scale investigations on dry eye related problems in RGP and soft lens wearers in the future. The presented correlations, although in most cases weak or moderate, show trends that may assist in advising, monitoring and ultimately treating contact lens wearers.

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Conflict of interest : None to declare.

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