The association between contact lens wear and the meibomian gland dysfunction in Ophthalmology department, Thammasat hospital, Pathum Thani, Thailand

Wimolwan Tangpagasit[1], Waraporn Mitsuntisuk[1], Lisa Chatsudthipong[1]

[1]Department of ophthalmology, Thammasat University, Pathum Thani,

Purpose: To determine the prevalence of Meibomian gland dysfunction (MGD) in contact lens wearers and the effect of different modalities of contact lens (CL) on parameters related to MGD in. Thammasat hospital, Pathum Thani province.

Methods: Cross-sectional study. 75 contact lens wearer subjects (ages 20-50 years old). The subjects' health history and symptoms were assessed using questionnaire. The assessment of MGD and dry eye symptoms was conducted by a self-reported ocular symptom using ocular surface disease index (OSDI).

Results: There was a significant association between the severity of MGD and artificial tear used, participants who used artificial tear have less severity of MGD 1.36 compare to non-used group 1.63 ($P = 0.01$). It was found that severity of MGD had a significant correlation with color of CL ($P = 0.023$). The tinted and big eye CL seemed to produce higher degree of MGD comparing to clear CL, suggesting that CL material was significantly related to severity of MGD. Short time of CL wear per day seems to have lower severity of MGD.

Conclusions: MGD was found to be common in contact lens wearers' subjects in Pathum Thani province, up to 74.7%. The severity of MGD had significant correlation with CL material.

Conflicts of interest: The authors report no conflicts of interest.

Keywords: contact lens wear, meibomian gland dysfunction, ocular surface disease index, Pathum Thani Province

EyeSEA 2019;14(2):89-98

DOI: https://doi.org/10.36281/2019020206

Introduction

Contact lenses have become very popular, not only for its use to correct a refractive error but also widely used in cosmetic way. However, wearing contact lens for a long period of time could lead to the development of many complications, such as dry eye, corneal surface abnormalities (corneal abrasion) and allergic conjunctivitis or infection. Among these, one of the most common complications observed is dry eye. Dry eye disease (DED) is characterized as either aqueous-deficit dry eye (ADDE) or evaporative dry eye (EDE).[1] It is a common, complex disease that causes symptoms of eye discomfort, change in visual acuity and tear film instability with potential damage to the ocular surface. Dry eye disease normally occurs due to an abnormality of

Correspondence to:
Wimolwan Tangpagasit, Thammasat University
E-mail: twimolwan@gmail.com
Received : 30th December 2018
Accepted: 10th February 2019
Published: 10th October 2019

tear film production (quality) or quantity of tear film components. Tear film has 3 layers; the innermost is mucin layer, secreted from goblet cell. The second layer is aqueous layer which secreted from lacrimal gland. The outermost is lipid layer which secreted from Meibomian gland. It is well recognized that defective formation of the lipid layer of tear film due to Meibomian gland dysfunction (MGD) could lead to evaporative dry eye disease (EDE).[2] This is consistent with the finding that MGD is a major cause of EDE.[3-5] The key signs of MGD include MG dropout, altered MG secretion, and changes in the lid morphology.[6]

It has been estimated that there are at least 140 million contact lens (CL) wearers worldwide.[7] Approximately 50% of CL wearers reported dry eye symptoms.[8-11] Moreover, it was found that CL wearers present with dry eye symptoms 12 times higher than those who do not wear contact lens, and 5 times higher compare to those who wear glasses.[12] Many studies have examined the association between CL wear and MGD, suggesting that lens wear produced adverse changes in MG function. The prevalence of MGD and CL wearers in several studies was about 22-37%.[13] A strong correlation between Meibomian gland dysfunction (MGD) and contact lens wearer in Asian people was reported.[2]

Of note, wearing contact lens can cause MGD due to an obstruction of the glands by kerotoic plugs. A consequence of the Meibomian gland obstruction could lead to bacterial aggregation and inflammation that resulting in reduced tear film quality[14], increased osmolality and easily to evaporate.[3] In addition, the number of Meibomian glands was reported to decrease concurrent with the duration of contact lens wearers.[15] However, the association between CL wear and MGD remains inconclusive. The discrepancy could be due to the limitations in the study designs and several parameters involved including duration of CL wear, lifestyle and environmental factors. However, the prevalence of MGD in correlation with type and duration of contact lens wear has not been examined in the Thai population. Due to the raising concerns about the safety of their long-term CL use, this study was performed to evaluate the effect of different modalities of contact lens on parameter related to MGD. The results obtained from this study will provide safe and effective recommendation for contact lens wearer.

Materials and methods

Study population

The study comprised of 150 eyes from 75 contact lens wearer subjects with the ages ranged from 20 to 50 years who came to Ophthalmology department, Thammasat hospital. Subjects were excluded from the study if they have signs of acute eye infections, lid abnormalities, or systemic diseases that might affect dry eye disease such as Sjogren's syndrome. Moreover, the subjects using topical medications for instance, topical anti-glaucoma drug that may interfere with ocular surface diseases were also excluded but those using artificial tear were allowed to participate. An informed consent was obtained from the subjects prior to an examination. The subjects were requested to remove contact lens before examination.

The study design and protocols were approved by ethic committee of Thammasat University, Thailand (MTU-EC-OP-0-146/58).

We assessed the subjects' health history and symptoms using structured questionnaire. It included gender, age, comorbid diseases, current medication(s), artificial tear used, past history of ophthalmic surgery, details of contact lens; type, color, daily or monthly, duration of CL use, and lens brand. In addition, a self-reported ocular symptom using the Ocular Surface Disease

Index (OSDI) was also included in the questionnaire.[19]

An examination was performed in the following order: visual acuity, slit-lamp examination of lid margin, Meibomian gland's expression and function, tear break-up time and corneal staining.

After best-corrected visual acuity was recorded, subjects were examined in front of slit-lamp. The lid margin was examined and the score was graded as 1 (normal lid margin), 2 (irregular lid margin), 3 (plugging and vascularity) and 4 (drop out and displacement). Its debris was graded as 0 (none), 1 (1-5 crusts), 2 (6-10 crusts), and 3 (>10 crusts). In addition, the lid margin redness also graded as 4-point categorical scale (none, pink, light red and bright red) (Table 1).

Meibomian gland secretion was assessed in each of 8 glands at the central third of lower lid on a 0-3 scale for each gland (Table 2). Light digital pressure was applied constantly at both lower lids to examine Meibomian gland's secretion characteristics. Conjunctiva was examined and injection score was also assessed(Table2).

Tear film break-up time was measured by placing a fluorescein-impregnated strip in the lateral part of inferior fornix. Each subject was asked to blink several times. Cobalt blue light was then illuminated and the time before the corneal dry spot appeared in the stained tear film was recorded as the tear film break-up time. Subsequently, corneal staining was evaluated after reapplying of fluorescein staining under cobalt blue illumination. Appearance of corneal staining was recorded and graded on a 1-5 scale (none, minimal, mild, moderate, marked staining) as references from TFOS international workshop on Meibomian gland dysfunction[16] (Table 2).

Statistical Analysis

All statistical analyses were performed using SPSS. The data were presented as percentage (%) of the total subjects or mean values ± SD. The data were analyzed using one way ANOVA followed by LSD test to draw comparison between MGD and related variables of the subjects and that of the contact lens. A $P < 0.05$ was considered to be statistically significant in all analyses.

Results

The clinical characteristics of the 75 subjects whom were recruited and evaluated at Thammasart hospital between September [1], 2016 and April 30, 2017 are summarized in Table 3. The mean age was 26.14 (SD 7.23) years (range, 19-46 years), and 82.7% were woman. The 20 % of subjects has allergy, 74.7% has no underlying disease and 5.3% others. Moreover, the current medications used that might affect dry eye syndrome were shown in Table 3. It was found that most of the subjects have no drug history and only 13.3% used antihistamine drug. Subjects with history of Roaccutane, antihistamine and hormone used did not shown statistically higher incidence of MGD. Of note, about 70% of subjects used artificial tear as a single dose unit or monthly artificial tear. This may indirectly reflect dry eye symptom of CL wearers. In subjects with artificial tear used, the most frequency used is 3 times a day (16.0%). 96% of subjects had no previous ophthalmic surgery. As shown in Figure 1A, most of the subjects wear soft contact lens (96.0%) and only 3% wear rigid ones. Monthly contact lenses were the most commonly used by about 80.0% (figure 1C). Interestingly, there were varieties of CL used (Figure 1B). Those include clear lens (68%), tinted lens, lens that have had a dye incorporated into the lens material (13.3%), and big eye contact lens, lens with diameter larger than normal (2.7%). The rest wear more than one type. The duration of hours wearing contact lens of subjects each day were reported in various ranges as followed; less than 6 hours (4%), 6-8 hours (17.3%), [9-10] hours (37.4 %),

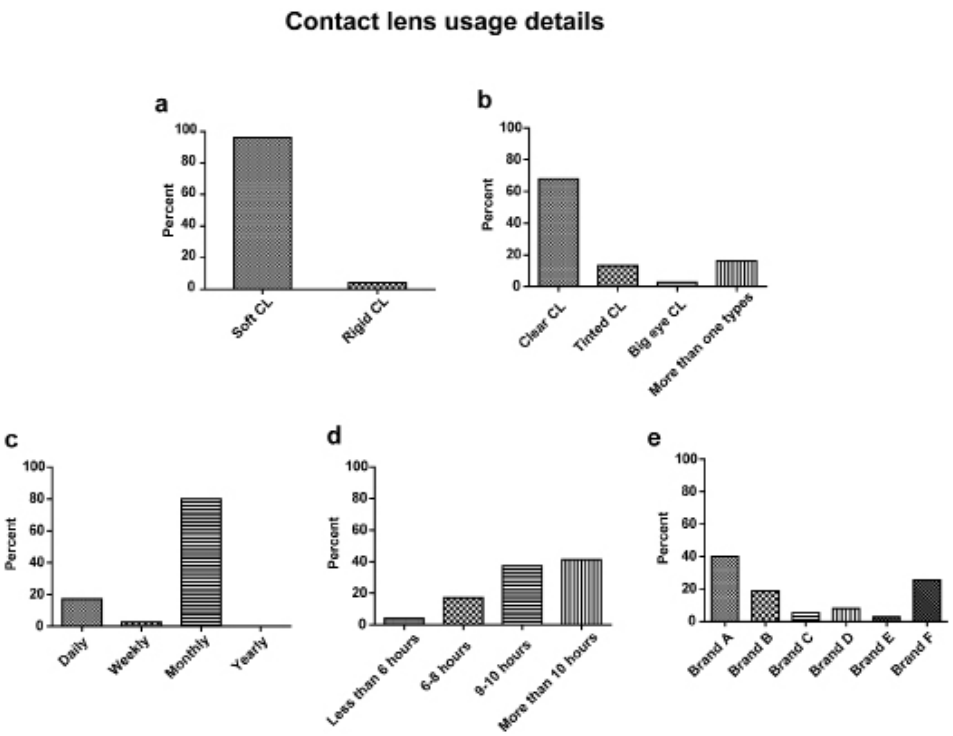

Figure 1: Contact lens usage details. A: type of CL, B: color of CL, C: CL wearing time, D: hours of wearing per day, E: Brand of CL

and more than 10 hours (41.3%) (Figure 1D). The mean duration of contact lens wear was 70.3 months (range 1-240 months, SD 57.51). The percentage of contact lens brands by which the subjects used was shown in Figure 1F.

Self-reported ocular symptoms or ocular surface disease index (OSDI) were measured as shown in Figure 2 with the result of mean value 24.37 (range 1-69, SD 15.78). The majority of subjects (86.7%) have best-corrected visual acuity at 20/20. In this study the prevalence of MGD in contact lens users were 74.7% (Grade 2) (Table 7). Similar to previous studies, the prevalence of dry eyes were also high in contact lens wearers. The severity of MGD was evaluated and graded using many parameters as shown in Table 2 and the results were shown in Figures 3, 4 and 5. There were the association between the severity of MGD and artificial tear used, participants who used artificial tear have less severity of MGD 1.36 compare to non-used group 1.63 ($P < 0.01$) (Figure 5D). Female participants have average severity of MGD at 1.54 and male participants at 1.48 ($P = 0.618$). Interestingly, there

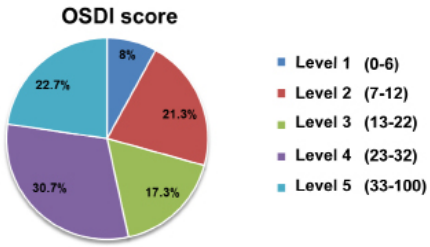

Figure 2: Distribution of OSDI score with the range between 1-69, mean value ± SD = 24.37 ± 15.78

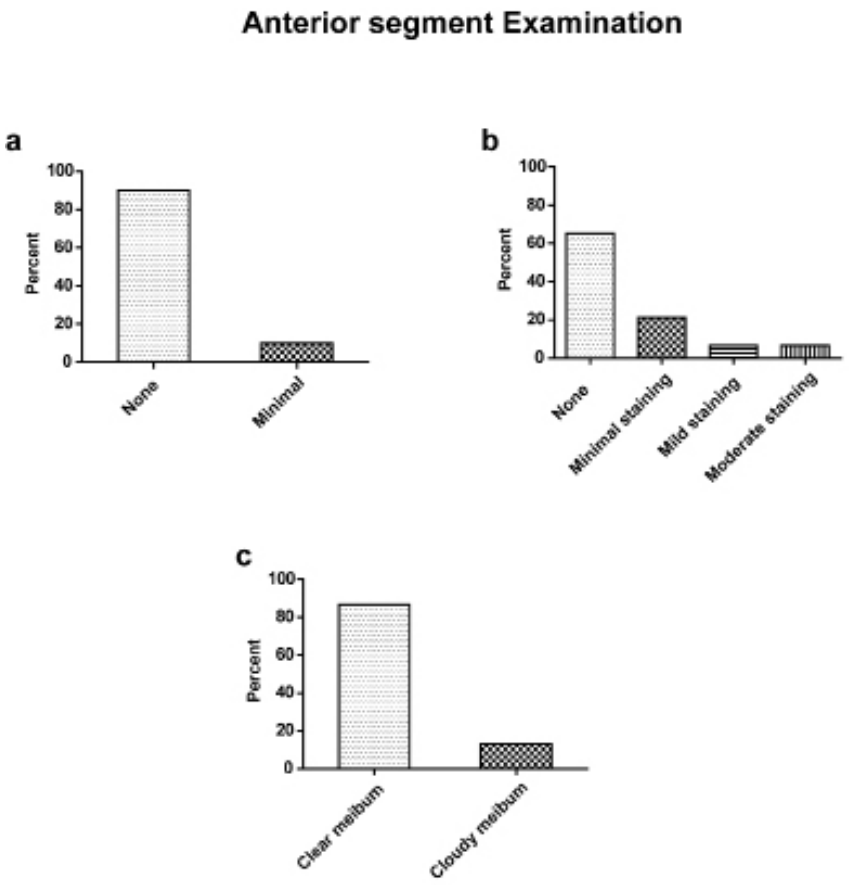

Figure 3: Anterior segment examinations. a Conjunctival injection score, b Corneal fluoresceine staining, c Meibomian gland quality grading

was no significant different in severity of MGD between age groups (P = 0.304). The severity of MGD in soft contact lens users are 1.53 and rigid contact lens users are 1.63 (P = 0.683). The severity of MGD in subjects who wear clear contact lens, tinted contact lens, big eye contact lens and others were at 1.53, 1.80, 1.83 and 1.29, respectively. It was noteworthy that the severity of MDG had significant correlation with color of CL (P <0.023) (Figure 6). The tinted and big eye CL seemed to produce higher degree of MGD severity comparing to clear CL, suggesting that CL material was significantly related to severity of MGD.

CL wearing time; daily, weekly and monthly, had an average MGD of 1.50, 1.56 and 1.54 respectively (P = 0.943). Notably, the hours of contact lens wear per day

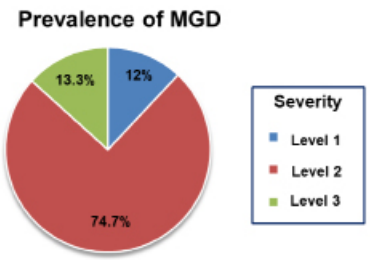

Figure 4: Prevalence of MGD with the range 1-3, mean value ± SD = 1.53 ± 0.42

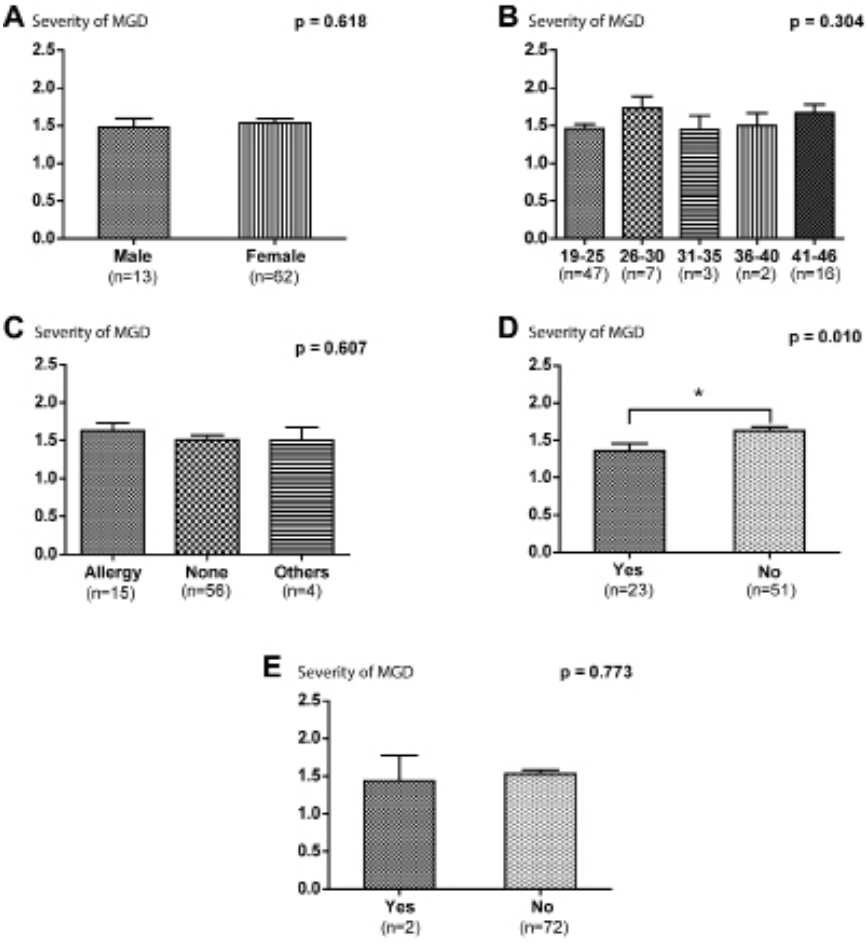

Figure 5: Severity of MGD compare with personal factors. A: Sex, B: Age, C: Underlying disease,D: Artificial tear use, E: Ocular surgery

seemed to have slightly effect on severity of MGD; more than 6 hours (1.28), 6-8 hours (1.44), 9-10 hours (1.52) and more than hours (1.57) (P = 0.676). Duration of CL wearing has no significant effect on severity of MGD (P = 0.687). These findings indicated that CL wearing time, hours of wearing per day, duration of lens wear and brands of CL were not significant factors related to MGD. However, short time of CL wear per day seems to have lower MGD.

In this study, we found that an increase in duration of CL wear seemed to have slightly effect on TBUT. As the duration of CL wearing is longer, the more potential of an increasing in TBUT score may appear (the more score is less TBUT). This reflects the effect of duration of CL wear on severity of dry eye and also the severity of MGD (Figure 7).

Of note, the lid margin score that reflects the function of MG had tendency to increase with increased wearing duration (Figure 8). Due to the small number of subjects who wore CL at longer duration, this makes it difficult to draw solid conclusion

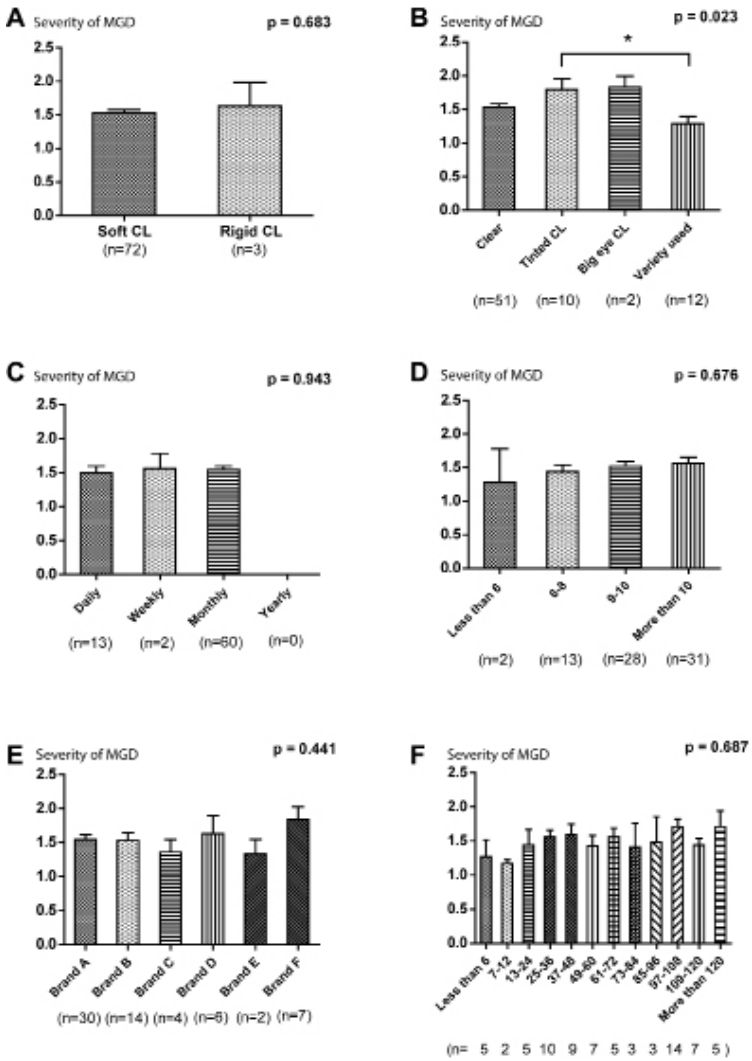

Figure 6: Severity of MGD in correlation with contact lens factors. a Type of CL, b Color of CL, c CL wearing time, d Hours of wearing per days, e Duration of CL use (months)

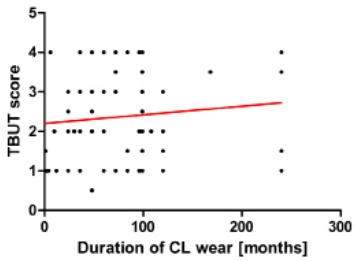

Figure 7: Scatter plot showing correlations between TBUT and duration of CL wearers in 75 subjects

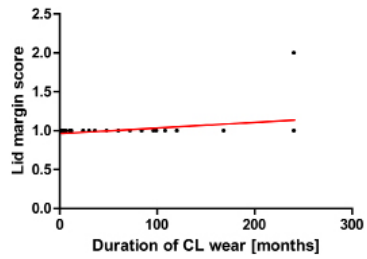

Figure 8: Scatter plot correlations between the lid margin score and duration of CL wearers in 75 subjects

on this assumption. However, it was likely that duration of CL wear might be an independent predictor of lid margin abnormalities.

Discussion

MGD is a multifactorial disease which is a major cause of EDE. It is commonly characterized by terminal duct obstruction and changes of meibum secretion. The proposed mechanism of MG obstruction is likely to be due to aggregation of desquamated epithelial cells into keratotic clusters that block the meibomian duct[13]. Without high quality meibum, the tear will evaporate quickly causing dry eye. It has been stated that 50% of CL wearers get dry eyes which making over 75% drop out of CL wearing because of dry eye[13]. To maintain their correct shape, contact lens need to be well hydrated. Thus, under certain conditions it is possible that CL could soak up tears on the ocular surface leading to dry eye. Although, the leading cause of dry eye symptom for CL wearers has been suggested to be due to MGD. The extent by which CL wear contributes to MGD is still unclear. In contrast, the lack of association between CL wear and MGD was also reported.[17] Since the high prevalence of MGD in Asian population has been reported, it is of interest to investigate the relationship between CL wear and various signs involving MGD inPathum Thani province. Our study found that MGD was common in Thai contact lens users, up to 74.7% in the study group. This is consistent with several previous studies showing that MGD was observed in contact lens used.[18]

Of note, MGD is likely to include multiple interactions between endogenous and exogenous factors. We then investigated the effect of different modalities of contact lens on parameters related to MGD. Concerning the type of CL, the data obtained from our study showing that rigid contact lens users had no significant different in severity of MGD compare to that of soft contact lens users. In fact, this finding was similar to that reported in previous study. However, our data was not strong enough evidence to make solid conclusion concerning the effect of the rigid contact on MGD due to the low number of subjects in this group (n=3). Therefore, higher numbers of subjects in this group is needed. Notably, other factors have been found to correlate well with the prevalence and severity of MGD in the present study. The different color of contact lens used was found to have significant different in severity of MGD (P = 0.023). Subjects, who wear big eye contact lens tended to have more severe MGD than that of the others with the mean value of 1.83. The one using variety (combination) of contact lens has less severity of MGD compare to tinted contact lens, 1.29 vs. 1.80 (P = 0.004). There was a report that duration of contact lens wear associated with meiboscore which represents severity of MGD. This is consistent with our study showing that the longer hours of contact lens wearing, the more possibility of MGD observed. In addition, there was a correlation between severity of MGD and artificial tear used. This finding is consistent with the results previously reported by Machalinska et al.[18].

In parallel, there were a few studies demonstrated the prevalence of lid margin and conjunctival abnormalities in CL wearers.[18] Of note, only a few weeks of daily CL wear a significant increase in the IL-6 tear film concentration was found despite normal conjunctival and corneal cell morphology. These data suggested that CL wear may affect ocular homeostasis and induce tear film inflammation.[18] Along the line, it has been proposed that CL wear may induce chronic irritation of MGs through conjunctiva which causes changes in MG function and meibum quality.[18] Our results are in agreement with this notion; we found changes in meibum quality and likelihood

of lid margin abnormality in CL wear (Figure 8). The longer period of CL wear may be required to see significant increase in lid margin abnormality in CL wear. The previous study has shown that lid margin abnormality start to observe after 10 year of CL wear.[18]

In addition, determination the association between CL wear and dry eye status using TBUT and conjunctival staining showed no significant correlation among these parameters. This might be explained by high frequency of artificial tear use by CL users. It is noteworthy that the frequency of artificial tear use correlates with ocular symptom score. This factor may have some influence on the results of our study to some extent. Due to the fact that the subjects in our study group are considered to be a young age population and composed mostly female, it may not be representative of the whole Thai population of CL users. Moreover, the longitudinal study of CL wear on MGD should be performed to establish better understanding of the link between duration of CL wear and the severity of MGD manifestation.

In conclusion, we have shown the evidence that CL wear may predispose subject to MGD. The severity of MDG had significant correlation with CL material. The possibility of MGD is normally not investigated unless significant symptoms are developed. Therefore, the routinely MGD examination of CL wearers is recommended for early and effective management.

Acknowledgement

This work was supported by Thammasat University research fund for graduate study. We would like to thanks Mr. Chamnan Yibcharoenporn for preparation of the figures for this manuscript.

References

1.Holly FJ. Tear film physiology. Am J Optom Physiol Opt. 1980;57(4):252–7.

2.Schaumberg DA, Nichols JJ, Papas EB, Tong L, Uchino M, Nichols KK. The international workshop on meibomian gland dysfunction: report of the subcommittee on the epidemiology of, and associated risk factors for, MGD. Invest Ophthalmol Vis Sci. 2011;52(4):1994–2005.

3.Lemp MA. Report of the National Eye Institute/Industry workshop on Clinical Trials in Dry Eyes. CLAO J. 1995;21(4):221–32.

4.Shimazaki J, Sakata M, Tsubota K. Ocular surface changes and discomfort in patients with meibomian gland dysfunction. Arch Ophthalmol. 1995;113(10):1266–70.

5.Mathers WD. Ocular evaporation in meibomian gland dysfunction and dry eye. Ophthalmology. 1993;100(3):347–51.

6.Tomlinson A, Bron AJ, Korb DR, Amano S, Paugh JR, Pearce EI, et al. The international workshop on meibomian gland dysfunction: report of the diagnosis subcommittee. Invest Ophthalmol Vis Sci. 2011;52(4):2006–49.

7.Subbaraman LN. An overview of new contact lens technologies, with a focus on what lens characteristics impact wearing comfort. Contact Lens Spectr. 2017.

8.Doughty MJ, Fonn D, Richter D, Simpson T, Caffery B, Gordon K. A patient questionnaire approach to estimating the prevalence of dry eye symptoms in patients presenting to optometric practices across Canada. Optom Vis Sci. 1997;74(8):624–31.

9.Nichols JJ, Mitchell GL, Nichols KK, Chalmers R, Begley C. The performance of the contact lens dry eye questionnaire as a screening survey for contact lens-related dry eye. Cornea. 2002;21(5):469–75.

10.Begley CG, Chalmers RL, Mitchell GL, Nichols KK, Caffery B, Simpson T, et al. Characterization of ocular surface symptoms from optometric practices in North America. Cornea. 2001;20(6):610–8.

11.Begley CG, Caffery B, Nichols KK,

Chalmers R. Responses of contact lens wearers to a dry eye survey. Optom Vis Sci. 2000;77(1):40–6.
12.Nichols JJ, Ziegler C, Mitchell GL, Nichols KK. Self-reported dry eye disease across refractive modalities. Invest Ophthalmol Vis Sci. 2005;46(6):1911–4.
13.Arita R, Fukuoka S, Morishige N. Meibomian Gland Dysfunction and Contact Lens Discomfort. Eye Contact Lens. 2017;43(1):17–22.
14.Henriquez AS, Korb DR. Meibomian glands and contact lens wear. Br J Ophthalmol. 1981;65(2):108–11.
15.Arita R, Itoh K, Inoue K, Kuchiba A, Yamaguchi T, Amano S. Contact lens wear is associated with decrease of meibomian glands. Ophthalmology. 2009;116(3):379–84.
16.Geerling G, Tauber J, Baudouin C, Goto E, Matsumoto Y, O'Brien T, et al. The international workshop on meibomian gland dysfunction: report of the subcommittee on management and treatment of meibomian gland dysfunction. Invest Ophthalmol Vis Sci. 2011;52(4):2050–64.
17.Ong BL. Relation between contact lens wear and Meibomian gland dysfunction. Optom Vis Sci. 1996;73(3):208–10.
18.Machalińska A, Zakrzewska A, Adamek B, Safranow K, Wiszniewska B, Parafiniuk M, et al. Comparison of Morphological and Functional Meibomian Gland Characteristics Between Daily Contact Lens Wearers and Nonwearers. Cornea. 2015;34(9):1098–104.
19.Ozcura F, Aydin S, Helvaci MR. Ocular surface disease index for the diagnosis of dry eye syndrome. Ocul Immunol Inflamm. 2007;15(5):389–93.