Original Article

Correlation of Size and Redness of Pterygium on Tear Film and Dry Eye Symptoms

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Abstract

Purpose: This study aimed to investigate the correlation of size and redness of pterygium to tear film and dry eye symptoms.

Setting/Venue: Thammasat University Hospital, Thailand

Materials and Methods: 976 patients joined a hospital-based, retrospective cross-sectional study in Thammasat University Hospital. Severity of pterygium was measured and collected by size and redness; Tear film was measured and collected by Tear meniscus height (TMH) and Tear break up time (TBUT); Dry eye syndrome was measured and collected by Ocular surface visual analogue scale (VAS), Ocular Surface Disease Index (OSDI), Oxford corneal staining scale and Meibomian gland dysfunction grading. The study was analyzed for correlation, using statistical tools of simple linear regression, Pearson correlation and Anova.

Results: 328 pterygium patients were identified, and information collected. The average horizontal and vertical size of pterygium was 2.74 mm and 2.45 clock hours. The most common redness grading was intermediate (176/328:53.66%). The relationship between horizontal size, vertical size and redness of pterygium with dry eye symptoms and tear film was (R = 0.32, 0.29 and 0.64) with a significance of <0.001, 0.005 and <0.001. The strongest correlation found was in redness of pterygium with OSDI scores, TBUT and Oxford corneal staining scale (R = 0.58, -0.46 and 0.38) with a significance of <0.001.

Conclusions: Pterygium patients were found to be 33.6 percent in this hospital-based, retrospective cross-sectional study. Horizontal size, Vertical size and redness of pterygium were related to tear film and dry eye symptoms. Redness of pterygium was the most important clinical feature affecting tear film and dry eye symptoms.

Keywords: Size, Redness, Pterygium, Tear film, Dry eye symptoms

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Introduction

Pterygium, one of the most common ocular surface diseases in ophthalmology practice, is a wing-shaped conjunctival tissue growth from the conjunctiva to the cornea.[1] Blurred vision due to astigmatism, appearance, and an irritated eye are important chief complaints with pterygium patients. Prevalence is roughly around 10% depending on the geographical location and is more common in the equator area or pterygium belt.[2,3] Many studies have researched the cause of pterygium, but it is still unclear. However, hereditary factors have been noted as a possible cause, and pterygium progression has a higher prevalence in areas exposed to greater ultraviolet radiation.[4-9] Since pterygium is an abnormal conjunctival tissue growth, there is an impact on symptoms from the ocular surface and tear film. Many studies have evidence of a correlation between pterygium and dry eye disease.[10-11]

Based on the report from the Dry Eye Workshop (DEWS II), dry eye disease is the most common problem of eye health. Moderate to severe dry eye disease was shown to be similar to moderate to severe angina, in quality-of-life studies. Dry eye disease has been defined as a disease of the ocular surface which has multifactorial causes and many various pathogenesis. The disease disrupts homeostasis of the tear film which appears in conjunction with ocular symptoms associated with hyperosmolar tears, tear film instability, inflammation of the eye surface, and loss of sensory perception of the eyes.[12-13] As population surveys show, electronic tools are a factor that cause eye disorders among office workers, particularly dry eye symptoms. The prevalence of dry eye was found to be more than half in a population of digital usage users.[14]

In a study conducted by Lekhanont and colleagues, dry eye disease had a prevalence rate of 34% among 550 participants who visited the ophthalmology department for their annual eye exam, with more than 50% of these patients also having pterygium.[15,16] Another study in Pathum Thani showed more than 70-85% of pterygium patients have dry eye symptoms.[17]

Erkut Kucuk and colleagues performed a study which investigated tear film function and dry eye syndrome, and it showed young patients with pterygium had lower Schirmer II test results, lower TBUT values, and higher OSDI scores compared to the control group.[18] Another study, by Jeremy Tan and colleagues, showed pterygium recurrence was associated with a greater severity of dry eye, possibly by perpetuating ocular surface inflammation in the postoperative period.[19] Also, Huping Wu and colleagues showed a correlation between Meibomian Gland Dysfunction (MGD) parameters and ocular discomfort, as well as dry eye indexes, and these findings suggest that MGD correlates with tear film instability and ocular discomfort as seen in patients with pterygium.[20]

As there are many ways for grading severity of pterygium, size and redness were chosen as two common characteristics. This study intended to assess the correlation of size and redness of pterygium to tear film and dry eye symptoms. These results could be useful in pterygium care.

Materials and Methods

This study was approved by the Research Ethics committee 1, the Faculty of Medicine, Thammasat University. All methods were performed in accordance with the guidelines and regulations under Thammasat University Hospital.

The study was performed by retrospective reviews of data from the Pterygium Screening Project at Thammasat Hospital, which collected data in a hospital-based, cross-sectional study at Thammasat University Hospital. The criteria for enrollment included patients with pterygium, aged between 15-80 years. The criteria for exclusion included those who were not mentally capable and could not provide the data required for the study.

Data collection included the following information: age, gender, education, occupation and type of pterygium. Moreover, severity levels of symptoms and signs on the ocular surface such as eye pain, eye irritation, eye tearing, blurred vision, red eye, and level of disturbances in daily life were collected as a visual analog scale (VAS) (1-10 points). Evaluation of dry eye symptoms were recorded by ocular surface disease index (ODSI).[21] All patients were examined by standard slit lamp for evaluating severity of pterygium, including size and redness. The horizontal size of pterygium

was calculated by slit lamp measurements, and the vertical size by using clock hours. Redness severity was observed as Tan grading,[22] and was evaluated by morphology and fleshiness: 1 for atrophic, 2 for intermediate and 3 for fleshy. Tear film was collected by tear meniscus height (TMH), tear break up time (TBUT) with fluorescein staining, Oxford corneal staining scale and Meibomian gland dysfunction grading.

The quantitative data was displayed as numbers, which were subsequently analyzed to obtain percentages and mean by using ANOVA, Regression analysis and correlation analysis by Pearson correlation coefficient. The results were considered statistically significant at $p \leq 0.05$. Statistical analysis was performed using the SPSS software version 22.0 (SPSS Inc, Chicago, IL).

The data was reviewed from the questionnaire collected at Thammasat University Hospital. The questionnaire obtained patient's information and was then tested with the simple content validity method by two ophthalmologists, specializing in cornea and glaucoma. Administrative staff also helped to verify the questionnaire's linguistic accuracy.[23-24] The Pterygium Screening Project at Thammasat Hospital was performed by the department of ophthalmology. All included patients were voluntary, and all the data was collected by 5 general ophthalmologists who were studying in a fellowship program (1 cornea and refractive surgery, 2 glaucoma and 2 retina fellowship).

Results

A total of 976 individuals participated in The Pterygium Screening Project at Thammasat University Hospital and answered the questionnaire. The study was collected as inclusion and exclusion criteria. According to the collected data, 328 patients of pterygium were collected, 314 patients as primary type and 14 patients as recurrent type. The range of age was 15-80 years, and the majority age group was 51-60 years of age which was represented by 105 patients (32%). The average age was 51.2 years. Two hundred seventeen male participants (66.2%) were more populous than the 111 female participants (33.8%). 102 patients (31.1%) graduated from primary education, and General labor was the most represented group with 97 patients (29.6%) (Table 1).

By horizontal size of pterygium: the average size was 2.74 millimeters, and grouped by size, less than 1.5 millimeters was 53 patients (16.2%), 1.5-4.0 millimeters were was 235 patients (71.6%) and more than 4.0 millimeters was 40 patients (12.2%). The three groupings of horizontal size, from small to large, showed a correlation with increasing dry eye severity levels of symptoms and signs as visual analog scale (VAS) (1-10 points) included eye pain, eye irritation, eye tearing, blurred vision, red eye, level of disturbances in daily life, OSDI scores. Size correlated with severity level of symptoms and signs. Tear film as tear meniscus height (TMH), tear break up time (TBUT) with fluorescein staining, Oxford corneal staining scale and meibomian gland dysfunction grading are shown in Table 2. Average vertical size was 2.45 clock hours. Vertical size of pterygium was grouped into 5 categories following 1, 2, 3, 4 and 5 clock hours, and a correlation with increasing dry eye severity level of symptoms and signs as visual analog scale (VAS), and OSDI scores, was noted too. correlated with severity of levels of. Tear film as tear meniscus height (TMH), tear break up time (TBUT) with fluorescein staining, Oxford corneal staining scale and meibomian gland dysfunction grading are shown in Table 3. The most common redness grading was intermediate in 176 patients (53.7%). Redness level, separated into 3 groups, showed increasing dry eye severity levels of symptoms and signs as visual analog scale (VAS), and OSDI scores, and these groups correlated with severity of levels of symptoms and signs as well.

Table 1 Demographic and clinical data of patients (n = 328)

Characteristics	Type of pterygium		
Age (years)	Primary N (%) n = 314	Recurrent N (%) n = 14	Total N (%)
< 30	16 (5.1)	0 (0.0)	16 (4.9)
30-40	53 (16.9)	4 (28.6)	57 (14.7)
41-50	71 (22.6)	2 (14.3)	73 (22.3)
51-60	99 (35.1)	6 (42.9)	105 (32.0)
61-70	61 (19.4)	1 (7.1)	62 (18.9)
> 70	14 (4.5)	1 (7.1)	15 (4.6)
Mean age	51.21	50.9	51.2
Gender			
Female	105 (33.4)	6 (42.9)	111 (33.8)
Male	209 (66.6)	8 (57.1)	217 (66.2)
Education			
Uneducated	36 (11.5)	4 (28.6)	36 (11.0)
Primary education graduates	98 (31.2)	1 (7.1)	102 (31.1)
High school graduates	72 (22.9)	7 (50.0)	73 (22.3)
Bachelor's degree graduates	75 (23.9)	2 (14.3)	82 (25.0)
Vocational education graduates	33 (10.5)	0 (0%)	35 (10.7)
Occupation			
Unemployed	76 (24.2)	1 (7.1)	77 (23.5)
General labourers	93 (29.6)	4 (28.6)	97 (29.6)
Officer	28 (8.9)	3 (21.4)	31 (9.5)
Farmer	41 (13.1)	2 (14.3)	43 (13.1)
Officialdom	27 (8.6)	1 (7.1)	28 (8.5)
Private business owners	13 (4.1)	2 (14.3)	15 (4.6)
Merchant	36 (11.5)	1 (7.1)	37 (11.3)

The relationship between horizontal size of pterygium, dry eye symptoms and tear film was assessed by using Pearson correlation coefficient and the simple linear regression analysis at the statistical significance level of 0.05. The results revealed a significant relationship between horizontal size of pterygium with eye tearing, blurred vision, red eye, VAS total, and OSDI scores. The overall Pearson correlation coefficient was 0.32 as shown in Table 2 and Figure scatterplot 1.

Furthermore, the relationship between vertical size of pterygium, dry eye symptoms and tear film were assessed by using Pearson correlation coefficient and the simple linear regression analysis at the statistical significance level of 0.05. The results revealed a significant relationship between vertical size of pterygium and blurred vision, red eye, VAS total, OSDI scores and Tear meniscus height. The overall relationship was 0.29 as shown in Table 3 and Figure scatterplot 2.

In addition, the relationship between redness of pterygium, dry eye symptoms and tear film were assessed by using Pearson correlation coefficient and the simple linear regression analysis at the statistical significance level of 0.05. The results revealed a significant relationship between vertical size of pterygium and every dry eye symptom and tear film parameter except tear meniscus height. The overall relationship was 0.64 as shown in Table 4 and Figure scatterplot 3.

Table 2 Relationship between Horizontal size of Pterygium and tear film and dry eye symptoms

Horizontal size of Pterygium	**Mean**	**SD**	**Mode**	**R (Pearson correlation)**	**P-value**	**Summary R**	**Summary R square**	**Summary p-value**
VAS Eye pain	3.83	2.88		0.21	0.35	0.32	0.10	<0.001
VAS Eye irritation	5.61	2.89		0.78	0.08			
VAS Eye tearing	4.50	3.14		0.17	<0.001*			
VAS Blur vision	5.83	3.09		0.16	0.02*			
VAS Red eye	5.71	3.25		0.16	0.02*			
VAS Disturb daily life	6.36	3.13		0.08	0.07			
VAS total	31.87	14.38		0.15	0.004*			
OSDI scores	21.57	10.06		0.17	<0.001*			
Tear meniscus height: TMH (mm)	0.285	0.13		0.05	0.17			
Tear break up time: TBU (s)	8.87	4.11		-0.03	0.30			
Oxford corneal staining scale			Grade 2 (118/328) (35.98%)	0.04	0.26			
Meibomian gland dysfunction grading			Grade 1 (138/328) (42.07%)	-0.04	0.25			

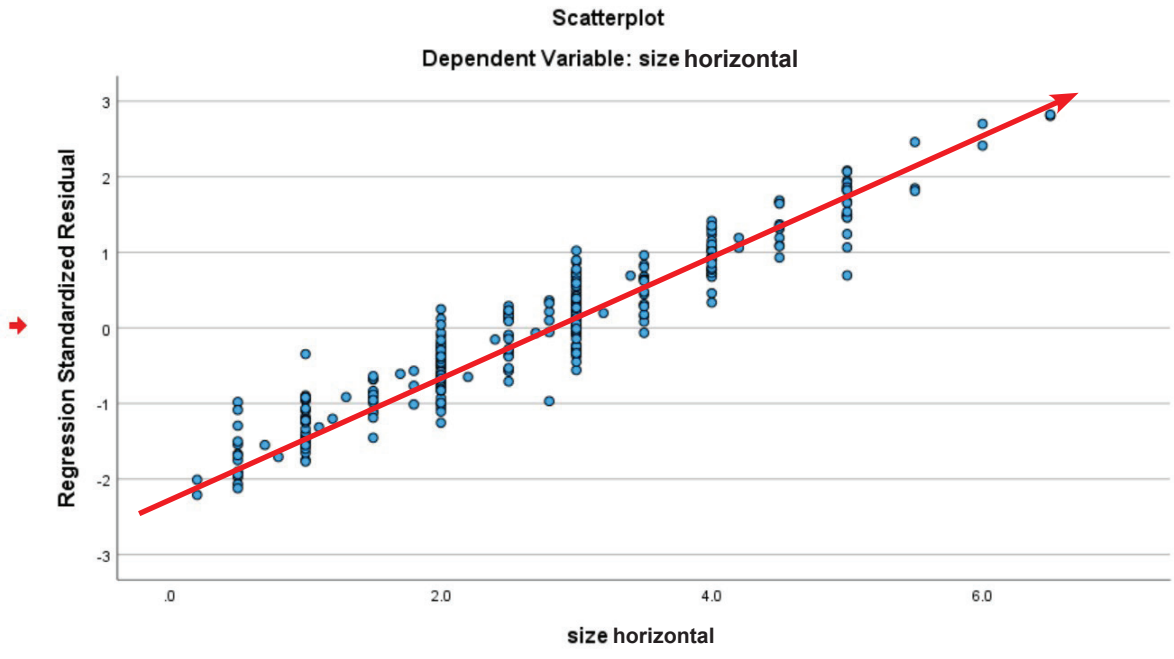

Figure 1 Relationship between horizontal size of pterygium and tear film and dry eye symptoms scatterplot

Table 3 Relationship between vertical size of Pterygium and tear film and dry eye symptoms

Vertical size of Pterygium	Mean	SD	Mode	R (Pearson correlation)	P-value	Summary R	Summary R square	Summary p-value
VAS Eye pain	3.83	2.88		0.18	0.38	0.29	0.08	0.005
VAS Eye irritation	5.61	2.89		0.07	0.10			
VAS Eye tearing	4.50	3.14		0.07	0.20			
VAS Blur vision	5.83	3.09		0.17	<0.001*			
VAS Red eye	5.71	3.25		0.13	0.01*			
VAS Disturb daily life	6.36	3.13		0.07	0.12			
VAS total	31.87	14.38		0.11	0.02*			
OSDI scores	21.57	10.06		0.11	0.02*			
Tear meniscus height: TMH (mm)	0.285	0.13		0.11	0.02*			
Tear break up time: TBU (s)	8.87	4.11		-0.10	0.30			
Oxford corneal staining scale			Grade 2 (118/328) (35.98%)	0.31	0.29			
Meibomian gland dysfunction grading			Grade 1 (138/328) (42.07%)	0.29	0.30			

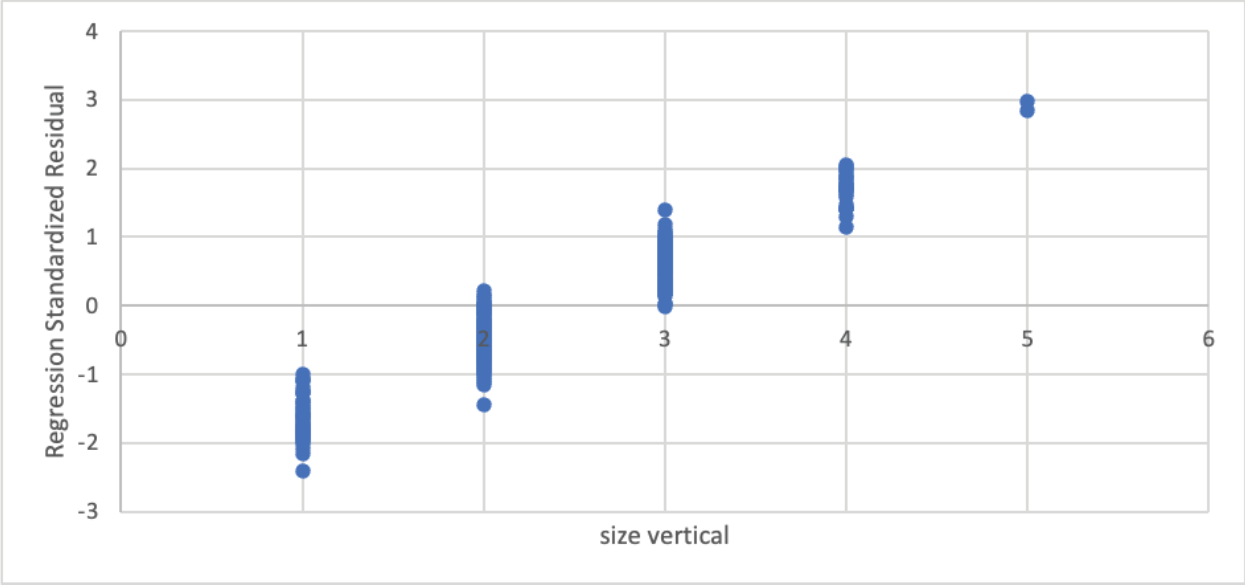

Figure 2 Relationship between vertical size of pterygium and tear film and dry eye symptoms

Table 4 Relationship between redness of pterygium and tear film and dry eye symptoms

Pterygium Redness	Mean	SD	Mode	R (Pearson correlation)	P-value	Summary R	Summary R square	Summary p-value
VAS Eye pain	3.83	2.88		0.25	<0.001*	0.643	0.414	<0.001
VAS Eye irritation	5.61	2.89		0.17	<0.001*			
VAS Eye tearing	4.50	3.14		0.18	<0.001*			
VAS Blur vision	5.83	3.09		0.20	<0.001*			
VAS Red eye	5.71	3.25		0.20	<0.001*			
VAS Disturb daily life	6.36	3.13		0.21	<0.001*			
VAS total	31.87	14.38		0.26	<0.001*			
OSDI scores	21.57	10.06		0.58	<0.001*			
Tear meniscus height: TMH (mm)	0.285	0.13		-0.05	0.17			
Tear break up time: TBU (s)	8.87	4.11		-0.46	<0.001*			
Oxford corneal staining scale			Grade 2 (118/328) (35.98%)	0.38	<0.001*			
Meibomian gland dysfunction grading			Grade 1 (138/328) (42.07%)	0.26	<0.001*			

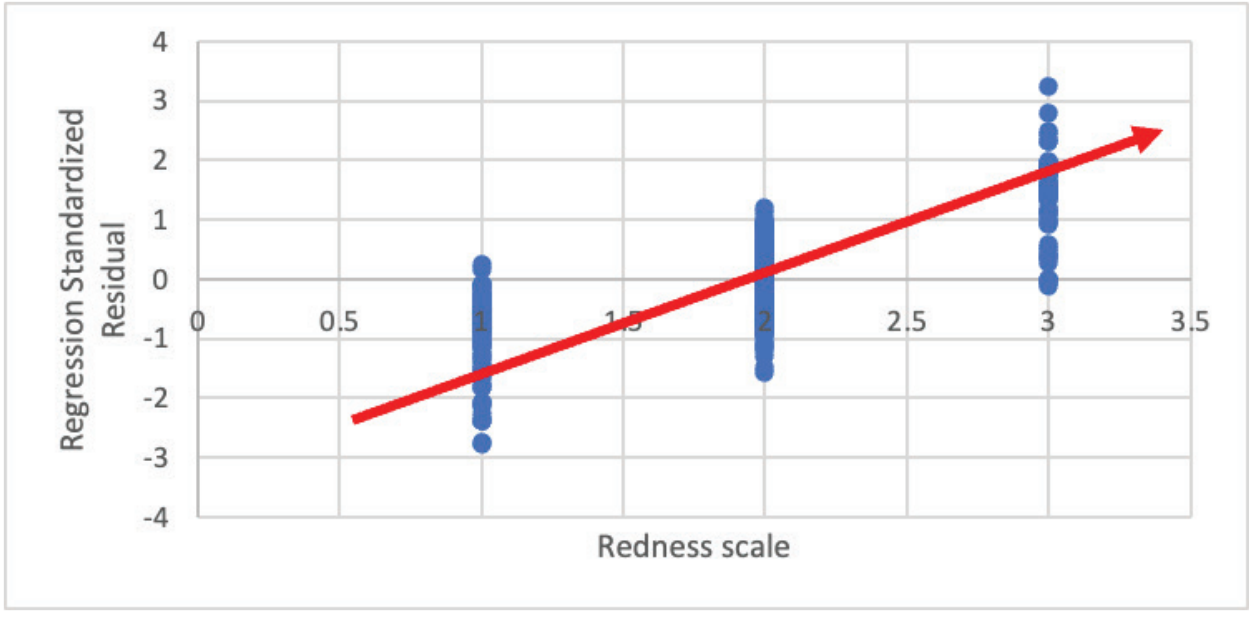

Figure 3 Relationship between redness of pterygium and tear film and dry eye symptoms

Discussion

Among 976 patients who joined in this project, we found 328 pterygium patients, of which the incidence was 33.6%. This Pterygium incidence was more than a prior incidence report.[25] It was assumed this project included patients who were aware of their own pterygium problems, and this could have influenced the incidence of pterygium in our study, since it gave patients an opportunity to be in a pterygium study.

In terms of severity of pterygium, there are many characteristics. This study observed size and redness of pterygium because these characteristics are two of the most common in clinical practice and could be applied in a real clinical setting. However, in terms of clinical symptoms which causes suffering to patients, these involved ocular surface symptoms. Qian L and colleagues,[26] in a meta-analysis study investigating risk factors for dry eye syndrome, found pterygium as one of risk factors influencing clinical dry eye. Regarding the pathogenesis of pterygium,[27] many theories exist with explanations such as tear film changes, inflammatory stimulation by cytokines and growth factor imbalance. Therefore, tear film expression and dry eye symptoms affect severity of pterygium.

For the size of pterygium, this study observed and measured horizontal and vertical dimensions. Horizontal size of pterygium, organized into three groups following small to large, showed that dry eye severity levels as OSDI scores and tear break up time (TBUT) correlated with severity. These results were similar to results reported in Erkut Kucuk and colleagues' study, investigating tear film function and dry eye syndrome, which showed that young patients with pterygium had lower TBUT values, and higher OSDI scores compared to the control group.[19] However, our study investigated more dry eye severity levels of symptoms, which included a visual analog scale (VAS) (1-10 points), eye pain, eye irritation, eye tearing, blurred vision, red eye, level of disturbances in daily life, Tear film as tear meniscus (TMH), Oxford corneal staining scale and meibomian gland dysfunction grading, and these correlated with larger horizontal size. Similarly, vertical size of pterygium, separated into five groups following 1, 2, 3, 4 and 5 clock hours, showed correlation with increasing dry eye severity levels of symptoms and signs too, including visual analog scale (VAS), and OSDI scores. Tear film as tear meniscus height (TMH), tear break up time (TBUT) with fluorescein staining, Oxford corneal staining scale and meibomian gland dysfunction grading correlated with the larger vertical size.

Redness of pterygium, separated into 3 groups, showed increasing dry eye severity levels of symptoms and signs as visual analog scale (VAS),

and OSDI scores, and these groups correlated with severity of levels of symptoms and signs. Tear film as tear meniscus height (TMH), tear break up time (TBUT) with fluorescein staining and Oxford corneal staining scale were shown to have a correlation with the severity of redness. Ozsutcu M and colleagues investigated tear break up time (TBUT), fluorescein corneal staining, and conjunctival redness in pterygium patients compared with a control group, and they found a correlation between these characteristics and pterygium.[28] These outcomes were the same in our study.

In addition, meibomian gland dysfunction grading was a parameter our study evaluated. Huping Wu and colleagues showed a correlation between MGD parameters and ocular discomfort, as well as dry eye indexes, and these findings suggest that MGD correlates with tear film instability and ocular discomfort as seen in patients with pterygium.[20] Our study found a correlation between severity of redness and meibomian gland dysfunction grading, but regarding size, we did not find a correlation. We suggest further studies should investigate in this issue.

The relationships between horizontal size, vertical size, and redness with dry eye symptoms and tear film, were also assessed by using Pearson correlation coefficient and simple linear regression analysis. We found that redness of pterygium had the strongest relationship, 0.64, the next was horizontal size, 0.32 and then vertical size, 0.29.

There are limitations associated with this research which retrospectively collected data with a subjective questionnaire from patients who may have data collection bias. Even this study, which was a hospital-based, retrospective cross-sectional study, collected from a diverse population, may have selection bias and limited generalizability. Although there are some limitations of this study, the obtained information may be beneficial for future research.

Conclusion

The incidence of pterygium was 33.6 percent in this hospital-based study. Horizontal size, Vertical size and redness of pterygium were related to tear film and dry eye symptoms. Redness of pterygium was the most important clinical feature associated with tear film and dry eye symptoms.

What is already known on this topic?

According to previous studies, the results suggested that pterygium affected with dry eye symptoms and tear film. However it still has no data about relationship severity of pterygium and dry eye symptoms and tear film. Moreover, Thai population particularly the patients with pterygium, remained limitation of data.

What is this study add?

Report affecting size and redness of pterygium to tear film and dry eye symptoms.

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Potential conflicts of interest

The authors declare no conflict of interest.

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