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Research Article

Association between Demodex and Severity of Meibomian Gland Dysfunction: A Case Study

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Abstract

Background: Dry eye disease is a prevalent condition affecting the ocular surface, leading to discomfort, inflammation and potential vision loss. Among its various causes, Meibomian Gland Dysfunction (MGD) and the presence of Demodex mites are notable contributors.

Objective: This study aims to investigate the relationship between Demodex infestation and the severity of MGD.

Methods: A total of 30 patients (60 eyes) treated at Thammasat Hospital were enrolled. Comprehensive eye examinations, including best-corrected visual acuity, slit-lamp biomicroscopy and meibomian gland assessment using the Keratograph 5 M, were performed. Eyelash samples were collected to detect Demodex presence under microscopy. Statistical analyses were conducted to explore correlations between Demodex detection, MGD severity, age and gender.

Results: The mean age of participants was 59.83 ± 15.27 years. Demodex was detected in 21.7% of eyes, with a significant association found between age over 60 and Demodex presence ($p = 0.028$). No correlation was observed between Demodex detection and the severity of MGD, nor between Demodex presence and gender.

Conclusions: This study indicates that while Demodex infestation is more prevalent in older patients, it does not correlate with the severity of meibomian gland dysfunction. Further research with larger sample sizes and advanced methodologies is warranted to better understand the interplay between Demodex and dry eye disease.

Keywords: Demodex; Meibomian Gland Dysfunction; Dry Eye Disease; Ocular Surface Disease; Age-Related Ocular Changes

Introduction

Dry Eye Disease (DED) is a persistent condition marked by inflammation and damage to the ocular surface, leading to symptoms such as discomfort, visual disturbances and a risk of vision loss. This condition intensifies inflammatory responses in both the cornea and conjunctiva, contributing to considerable morbidity [1]. The prevalence of DED can differ significantly, ranging from 5% to 50%, with estimates as high as 75% among those aged 40 and older [2,3]. Various factors contribute to this condition, which is generally categorized into two main types: inadequate tear production and Evaporative Dry Eye (EDE) [4].

EDE occurs when the lipid layer of the tear film fails to effectively cover the aqueous layer, resulting in excessive tear evaporation and dry eye symptoms [5]. The lipid components are generated by the meibomian glands located in the eyelids, making Meibomian Gland Dysfunction (MGD) a major contributor to EDE [6]. MGD has been linked to multiple ocular surface disorders and its management is essential for alleviating symptoms of dry eye [7].

The genus Demodex comprises over 100 species of mites; however, only two-Demodex folliculorum and Demodex brevis are found on human skin [8]. These mites thrive by consuming lipids and are predominantly found in sebaceous areas, such as the eyelid margins, where they can impair normal meibomian gland function [9]. Demodex folliculorum is approximately 0.3 to 0.4 mm in length, whereas Demodex brevis is smaller, measuring about 0.2 to 0.3 mm [10]. Both species are associated with various ocular conditions, including blepharitis, ocular rosacea and keratitis, as they can obstruct sebaceous glands and contribute to Meibomian Gland Dysfunction (MGD) [11,12]. This study aimed to explore the relationship between the presence of Demodex and the severity of meibomian gland dysfunction in patients diagnosed with dry eye disease.

Methodology

The study was approved by the Human Research Ethics Committee of Thammasat University. Participants were randomly recruited from patients treated by Dr. Thiti Wichayachiwin in the outpatient ophthalmology department at Thammasat Hospital in February 2024. Informed consent was obtained from all participants and the study adhered to the principles outlined in the Helsinki Declaration.

All participants underwent a thorough eye examination, including best-corrected visual acuity measurements, slit-lamp biomicroscopy and fundus examination. Additional assessments included:

- Keratograph 5 M (Oculus, Wetzlar, Germany): Used to evaluate MGD, with results classified as follows:
  - Grade 0: No MGD
  - Grade 1: Abnormality in less than one-third of the meibomian glands
  - Grade 2: Abnormality in one-third to two-thirds of the meibomian glands
  - Grade 3: Anomaly affecting more than two-thirds of the meibomian glands
- Demodex Testing: Eyelashes were gently plucked from the upper eyelid using jeweler forceps to obtain Demodex specimens. A total of six eyelashes (three from each side) were collected due to a higher density of sebaceous glands on the upper eyelid [13]. The samples were placed on a glass slide, moistened with 0.9% saline solution, covered with a coverslip and examined under a microscope at 25X magnification in the ophthalmology department.

Statistical analyses were performed using ANOVA for continuous data and Fisher's exact test for categorical variables. The relationship between Demodex detection and meiboscore severity was evaluated, along with secondary outcomes assessing associations between Demodex detection, gender and age over 60 years. A p-value of less than 0.05 was deemed statistically significant, with analyses conducted using STATA 17.

Results

Data were collected from 60 eyes of 30 patients, comprising 10 males and 20 females, with a mean age of 59.83 ± 15.27 years. Among the examined eyes, 13 (21.7%) exhibited detectable Demodex. As indicated in Table 1, no significant correlation was identified between the severity of MGD and age, gender or Demodex detection.

	Meiboscore			**p value**
	1 (n=17)	2 (n=27)	3 (n=16)	
Age	60±15.24	58.63±16.06	61.69±14.19	0.870
Gender(F:M)	12:5	17:10	11:5	0.884
Demodex detection	3 (17.65)	5 (18.52)	5 (31.25)	0.616

Table 1: Correlative analysis of potential predictor of meibomian gland dysfunction.

However, a significant association was noted between age over 60 and Demodex detection: in the over-60 age group, Demodex was found in 11.3% of cases, compared to only 2.23% in those under 60 (p = 0.028, Table 2). Our analysis showed no correlation between sex and Demodex detection (Table 3).

	Demodex (n %)		p value
	Found	Not Found	
Age >= 60	11 (84.62)	24 (51.06)	0.028
Age < 60	2 (15.38)	23 (48.94)	

Table 2: Correlative analysis between age and demodex detection.

	Demodex (n %)		p value
	1	0	
Male	3 (23.08)	17 (36.17)	0.513
Female	10 (76.92)	30 (63.83)	

Table 3: Correlative analysis between sex and demodex detection.

Discussion

Demodex mites have long been implicated in various ocular surface conditions, particularly in association with blepharitis, Meibomian Gland Dysfunction (MGD) and Dry Eye Disease (DED). Several studies have suggested that Demodex infestation may contribute to meibomian gland obstruction and inflammation, thereby exacerbating symptoms of evaporative dry eye. However, the strength and nature of this association remain controversial, with conflicting evidence in the literature regarding whether Demodex presence correlates with the severity of MGD. In this context, the present study aimed to investigate the relationship between the detection of Demodex mites and the severity of meibomian gland dysfunction in patients with dry eye disease. Contrary to some previous findings, our results did not reveal a significant correlation between Demodex presence and MGD severity. This suggests that while Demodex may coexist with DED, it does not necessarily exacerbate the dysfunction of the meibomian glands. The literature presents conflicting evidence regarding the association between Demodex infestation and MGD. For example, Cheng, et al., found that a high proportion of MGD patients (89.32%) had detectable Demodex, compared to only 43.55% in non-MGD patients [14]. This disparity may arise from variations in patient populations or methodologies used in different studies. Our findings, which show no significant correlation, highlight the complexity of DED and suggest that Demodex may not be a direct contributor to MGD severity. Interestingly, we noted that patients over 60 years of age exhibited a higher prevalence of Demodex infestation. This observation aligns with existing literature indicating that Demodex prevalence increases with age, possibly due to age-related changes in the ocular surface and sebaceous gland function [15]. This raises the possibility that age itself may be a confounding factor in studies linking Demodex to MGD. Understanding this distinction is important, as it suggests that age-related ocular changes, rather than Demodex infestation alone, may play a more prominent role in the pathogenesis of MGD in older adults. Recognizing the influence of age as an independent variable could help refine future diagnostic and treatment approaches by avoiding the over-attribution of MGD symptoms to Demodex presence alone. Furthermore, the study by Liang, et al., revealed a significant correlation between Meibomian Gland Dysfunction (MGD) and keratitis in younger patients infested with Demodex brevis. This suggests that both age and the specific species of Demodex may significantly influence clinical outcomes [16]. Therefore, future research should consider stratifying data by age and Demodex species to gain deeper insights into their interactions. In contrast, Jing reported no correlation between these factors [17].

Limitations

This study is limited by the inability to differentiate between Demodex folliculorum and Demodex brevis using light microscopy. These two species inhabit different areas of the eyelid and may have distinct pathological effects on the ocular surface. For example, *D. folliculorum* primarily resides in hair follicles, while *D. brevis* is found deeper in sebaceous glands, including the meibomian glands, potentially influencing gland dysfunction differently [8,16]. Additionally, the relatively small sample size restricts the statistical power of our findings and may not fully represent the broader patient population. The cross-sectional design of this study also limits our ability to determine causality between Demodex infestation and meibomian gland dysfunction. Similar limitations have been acknowledged in prior studies. Cheng, et al., noted the difficulty in distinguishing Demodex species and emphasized the need for molecular diagnostic methods for accurate identification [14]. Liang, et al., also highlighted the importance of species differentiation due to varying clinical implications, particularly between *D. brevis* and *D. folliculorum* [16]. Furthermore, Liu, et al., pointed out that species-specific pathogenic roles remain unclear and recommended future research using advanced molecular techniques to clarify these roles [17].

Future investigations employing molecular methods such as Polymerase Chain Reaction (PCR) and larger, longitudinal studies are warranted to better elucidate the specific contributions of Demodex species to ocular surface diseases and meibomian gland dysfunction.

Conclusion

In conclusion, our findings suggest that while there is an increased prevalence of Demodex in older patients, there is no direct correlation with the severity of MGD. Further research is needed to explore the multifactorial nature of DED, incorporating potential interactions between Demodex, age and other contributing factors to enhance our understanding and management of this complex condition.

Conflict of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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