



Assessment of Dry Eye Disease in Patients with Rosacea: A Cross-Sectional Study

Dr. Chandan Mal.¹, Dr. Rajeev Ranjan ²

¹ Assistant Professor, Saraswathi Institute of Medical Sciences, Department of Ophthalmology

² Assistant Professor, Department of Ophthalmology, Santosh Medical College

Abstract

Background: Rosacea is a chronic inflammatory skin disorder that commonly affects the central face and is frequently associated with ocular manifestations. Ocular involvement may result in tear film instability, meibomian gland dysfunction, and dry eye disease (DED), significantly affecting patients' quality of life. Despite its clinical importance, ocular rosacea often remains underdiagnosed.

Aim: To assess the prevalence and severity of dry eye disease in patients with rosacea and to evaluate associated ocular surface abnormalities.

Materials and Methods: This hospital-based cross-sectional study included 100 patients with clinically diagnosed rosacea. All participants underwent detailed dermatological and ophthalmological examinations. Dry eye disease was assessed using the Ocular Surface Disease Index (OSDI), Schirmer's Test I, Tear Film Break-Up Time (TBUT), fluorescein staining, and evaluation of meibomian gland dysfunction. Statistical analysis was performed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant.

Result: The majority of patients were females (62%), and the most common age group was 31–40 years (32%). Erythematotelangiectatic rosacea was the most prevalent subtype (42%). The most common ocular symptoms were foreign body sensation (58%), burning sensation (54%), and dryness (52%). Dry eye disease was detected in 68% of patients. Based on OSDI scores, 22% had mild, 30% had moderate, and 16% had severe dry eye disease. The mean OSDI score was 24.7 ± 11.6 , mean Schirmer's test value was 9.8 ± 4.2 mm, and mean TBUT was 8.1 ± 3.4 seconds. Meibomian gland dysfunction was present in 61% of patients, blepharitis in 48%, conjunctival hyperemia in 42%, and corneal staining in 24%. A significant association was observed between dry eye disease and longer duration of rosacea ($p < 0.001$), as well as rosacea subtype ($p = 0.01$).

Conclusion: Dry eye disease is highly prevalent among patients with rosacea and is strongly associated with meibomian gland dysfunction and ocular surface abnormalities. Routine ophthalmological screening of rosacea patients may facilitate early diagnosis and timely management of ocular involvement, thereby reducing morbidity and improving quality of life.

Keywords: Rosacea, Dry Eye Disease, Ocular Rosacea, Meibomian Gland Dysfunction, OSDI, Schirmer's Test, Tear Film Break-Up Time.

Introduction

Rosacea is a chronic inflammatory dermatological disorder primarily affecting the centrofacial region and is characterized by persistent erythema, flushing, telangiectasia, papules, and pustules. It is a multifactorial disease involving dysregulation of the innate immune system, neurovascular pathways, environmental triggers, and microbial factors. Although rosacea is traditionally considered a skin disease, ocular involvement is a common yet frequently underrecognized manifestation that can significantly affect patients' quality of life and visual function.¹⁻³

Ocular rosacea encompasses a spectrum of inflammatory conditions affecting the eyelids, conjunctiva, tear film, meibomian glands, and cornea. Patients commonly present with symptoms such as burning sensation, foreign body sensation, dryness, itching, photophobia, tearing, and blurred vision. Clinical findings may include blepharitis, meibomian gland dysfunction (MGD), conjunctival hyperemia, recurrent chalazia, and corneal involvement. In severe cases, untreated ocular rosacea may lead to corneal neovascularization, ulceration, scarring, and permanent visual impairment.⁴⁻⁶

The reported prevalence of ocular involvement in rosacea varies widely, ranging from 30% to 72%, depending on the population studied and diagnostic criteria employed. Interestingly, ocular manifestations may precede cutaneous signs in approximately 20% of patients, making diagnosis particularly challenging. Furthermore, studies suggest that ocular rosacea remains underdiagnosed because its symptoms often mimic other common ocular surface disorders, especially dry eye disease (DED).⁷⁻⁹

Dry eye disease is a multifactorial disorder of the ocular surface characterized by tear film instability, ocular discomfort, visual disturbance, and inflammation. Meibomian gland dysfunction, one of the hallmark features of ocular rosacea, contributes significantly to evaporative dry eye. Chronic inflammation of the eyelid margin and meibomian glands alters lipid secretion, destabilizes the tear film, and promotes ocular surface damage. Consequently, patients with rosacea exhibit a substantially higher prevalence of dry eye symptoms and signs compared to the general population.¹⁰⁻¹²

Recent epidemiological studies have demonstrated a strong association between rosacea and ocular comorbidities. Dry eye syndrome has been reported to occur significantly more frequently in patients with rosacea, with an adjusted odds ratio of approximately 1.89 compared to healthy controls. In addition, blepharitis, conjunctivitis, and chalazion are commonly observed among these patients, underscoring the importance of comprehensive ophthalmological evaluation.¹³

Despite increasing awareness regarding ocular rosacea, there remains a paucity of data evaluating the burden and severity of dry eye disease among rosacea patients, particularly in developing countries. Early identification of dry eye manifestations is crucial because timely intervention can prevent progression to more severe ocular complications and improve quality of life. Moreover, understanding the relationship between cutaneous disease severity and ocular surface involvement may facilitate multidisciplinary management involving dermatologists and ophthalmologists.¹⁴⁻¹⁶

Therefore, the present study was undertaken to assess the prevalence and severity of dry eye disease in patients with rosacea and to evaluate the ocular surface changes associated with this chronic inflammatory condition.

Materials and Methods

Study Design: This hospital-based cross-sectional observational study was conducted to assess the prevalence and severity of dry eye disease among patients diagnosed with rosacea. Participants: 24 children diagnosed with cerebral palsy, presenting with delayed speech/language developmental milestones, were registered.

Inclusion Criteria: - A confirmed diagnosis of CP in children aged 1–16 years presenting with delayed speech and language milestones based on history and/or clinical evidence suggestive of prenatal, perinatal, or postnatal risk factors.

Study Setting: The study was carried out in the Departments of Dermatology and Ophthalmology of a tertiary care teaching hospital over a period of one year.

Study Population: Patients presenting to the Dermatology Outpatient Department with a clinical diagnosis of rosacea were screened for eligibility and recruited consecutively during the study period.

Sample Size: A total of 100 patients with rosacea who fulfilled the inclusion criteria and provided informed consent were enrolled in the study.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants prior to enrollment. Confidentiality of patient information was maintained throughout the study.

Inclusion Criteria: Patients who met the following criteria were included:

1. Age ≥ 18 years.
2. Clinically diagnosed cases of rosacea.
3. Patients willing to participate and provide written informed consent.

Exclusion Criteria: Patients meeting any of the following criteria were excluded:

1. History of ocular surgery or trauma within the preceding six months.
2. Current use of contact lenses.
3. Presence of other ocular surface disorders unrelated to rosacea.
4. Known autoimmune diseases associated with dry eye syndrome, such as Sjögren syndrome.
5. Current use of topical ocular medications affecting tear film stability.
6. Patients with active ocular infections.

Data Collection: A detailed history was obtained from all participants, including demographic characteristics, duration of rosacea, subtype of rosacea, ocular symptoms, associated systemic illnesses, and medication history.

A comprehensive dermatological examination was performed to confirm the diagnosis and classify rosacea according to standard clinical criteria.

Ophthalmological Evaluation: All participants underwent a detailed ophthalmological examination performed by an ophthalmologist. The assessment included:

Visual Acuity Assessment: Best-corrected visual acuity was assessed using a standard Snellen chart.

Slit-Lamp Examination: Anterior segment examination was performed using a slit-lamp biomicroscope to identify eyelid margin abnormalities, blepharitis, meibomian gland dysfunction, conjunctival congestion, and corneal involvement.

Assessment of Dry Eye Disease: Dry eye disease was evaluated using both subjective and objective parameters.

Ocular Surface Disease Index (OSDI): Participants completed the Ocular Surface Disease Index questionnaire. The OSDI score was calculated according to standard guidelines and categorized as normal, mild, moderate, or severe dry eye.

Schirmer's Test I: Schirmer's Test I was performed without topical anesthesia. Standardized filter paper strips were placed in the lower conjunctival fornix of both eyes, and the extent of wetting after five minutes was recorded in millimeters.

Tear Film Break-Up Time (TBUT): Fluorescein dye was instilled into the conjunctival sac, and the interval between the last blink and appearance of the first dry spot on the corneal surface was measured. Three readings were obtained, and the average value was recorded.

Corneal and Conjunctival Staining: Fluorescein staining of the ocular surface was performed to assess epithelial damage. Staining patterns and severity were documented.

Meibomian Gland Evaluation: The eyelid margins and meibomian gland orifices were examined for evidence of meibomian gland dysfunction, including plugging, telangiectasia, and altered gland secretions.

Outcome Measures: The primary outcome measure was the prevalence of dry eye disease among patients with rosacea.

Secondary outcome measures included:

1. Severity of dry eye disease based on OSDI score.
2. Schirmer's test values.
3. Tear film break-up time.
4. Presence of meibomian gland dysfunction.
5. Association between rosacea characteristics and dry eye severity.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0.

Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. The Chi-square test or Fisher's exact test was used for comparison of categorical variables. Independent t-test or Mann–Whitney U test was used for comparison of continuous variables as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics of Study Participants

A total of 100 patients with rosacea were included in the study. The majority of participants belonged to the 31–40 years age group (32%), followed by 41–50 years (28%). Females constituted 62% of the study population, resulting in a female-to-male ratio of 1.6:1.

Table 1. Demographic Characteristics of Study Participants (n=100)

Variable	Category	n	%
Age Group (Years)	18–30	18	18.0
	31–40	32	32.0
	41–50	28	28.0
	>50	22	22.0
Gender	Male	38	38.0
	Female	62	62.0
Residence	Urban	64	64.0

	Rural	36	36.0
--	-------	----	------

Clinical Characteristics of Rosacea

Erythematotelangiectatic rosacea was the most common subtype observed in 42% of patients, followed by papulopustular rosacea in 38%. The mean duration of rosacea was 4.8 ± 2.6 years.

Table 2. Clinical Characteristics of Rosacea (n=100)

Variable	Category	n	%
Rosacea Subtype	Erythematotelangiectatic	42	42.0
	Papulopustular	38	38.0
	Phymatous	8	8.0
	Ocular Rosacea	12	12.0
Disease Duration	<2 Years	24	24.0
	2–5 Years	46	46.0
	>5 Years	30	30.0

Prevalence of Ocular Symptoms:

Foreign body sensation was the most common ocular symptom (58%), followed by burning sensation (54%) and dryness (52%). Photophobia was reported by 28% of patients.

Table 3. Distribution of Ocular Symptoms Among Rosacea Patients

Ocular Symptom*	n	%
Foreign Body Sensation	58	58.0
Burning Sensation	54	54.0
Dryness	52	52.0
Itching	40	40.0
Excessive Tearing	35	35.0
Redness	32	32.0
Photophobia	28	28.0
Blurred Vision	18	18.0

*Multiple responses possible.

Assessment of Dry Eye Disease: Dry eye disease was identified in 68% of patients based on clinical evaluation and OSDI scoring. Moderate dry eye was the most common category (30%), followed by mild dry eye (22%) and severe dry eye (16%).

Table 4. Severity of Dry Eye Disease Based on OSDI Score

OSDI Category	n	%
---------------	---	---

Normal (0–12)	32	32.0
Mild (13–22)	22	22.0
Moderate (23–32)	30	30.0
Severe (>32)	16	16.0
Total Dry Eye Cases	68	68.0

Objective Dry Eye Parameters: The mean Schirmer's test value was 9.8 ± 4.2 mm, while the mean Tear Film Break-Up Time (TBUT) was 8.1 ± 3.4 seconds. Meibomian gland dysfunction was observed in 61% of patients.

Table 5. Objective Ocular Surface Parameters

Parameter	Mean $\pm$ SD
OSDI Score	24.7 ± 11.6
Schirmer's Test (mm)	9.8 ± 4.2
TBUT (seconds)	8.1 ± 3.4

Table 6. Ocular Examination Findings (n=100)

Finding	n	%
Meibomian Gland Dysfunction	61	61.0
Blepharitis	48	48.0
Conjunctival Hyperemia	42	42.0
Corneal Fluorescein Staining	24	24.0
Recurrent Chalazion	12	12.0

Association Between Rosacea Duration and Dry Eye Disease: Patients with disease duration greater than 5 years demonstrated a significantly higher prevalence of dry eye disease compared to those with disease duration less than 2 years (90.0% vs 41.7%, $p < 0.001$).

Table 7. Association Between Duration of Rosacea and Dry Eye Disease

Disease Duration	Dry Eye Present n (%)	Dry Eye Absent n (%)	Total	p-value
<2 Years (n=24)	10 (41.7)	14 (58.3)	24	
2–5 Years (n=46)	32 (69.6)	14 (30.4)	46	
>5 Years (n=30)	27 (90.0)	3 (10.0)	30	<0.001*

*Chi-square test

Association Between Rosacea Subtype and Dry Eye Disease: The prevalence of dry eye disease was highest among patients with ocular rosacea (91.7%) followed by papulopustular rosacea (73.7%). The association between rosacea subtype and dry eye disease was statistically significant ($p=0.01$).

Table 8. Association Between Rosacea Subtype and Dry Eye Disease

Rosacea Subtype	Dry Eye Present n (%)	Dry Eye Absent n (%)	p-value
Erythematotelangiectatic (n=42)	24 (57.1)	18 (42.9)	
Papulopustular (n=38)	28 (73.7)	10 (26.3)	
Phymatous (n=8)	5 (62.5)	3 (37.5)	
Ocular Rosacea (n=12)	11 (91.7)	1 (8.3)	0.01*

*Chi-square test

Discussion

Rosacea is a chronic inflammatory dermatosis that frequently affects the ocular surface and adnexal structures. Ocular manifestations are often overlooked despite their substantial impact on visual comfort and quality of life. The present cross-sectional study assessed the prevalence and severity of dry eye disease among patients with rosacea and evaluated its association with clinical characteristics of the disease. In the present study, the majority of patients belonged to the 31–40 years age group (32%), followed by the 41–50 years age group (28%). Females constituted 62% of the study population. These findings are consistent with those reported by Abram et al.¹⁷, who observed that rosacea predominantly affects middle-aged adults and is more common among females. Similarly, Gether et al.¹⁸ reported a female predominance ranging from 60% to 70% in rosacea cohorts, which closely corresponds to our findings. The most common rosacea subtype observed in our study was erythematotelangiectatic rosacea (42%), followed by papulopustular rosacea (38%). Similar observations were reported by Tan and Berg¹⁹, who found erythematotelangiectatic rosacea to be the most prevalent clinical subtype, accounting for approximately 45% of cases. These findings suggest that vascular dysregulation remains a major pathogenic component in rosacea. Regarding ocular symptoms, foreign body sensation (58%), burning sensation (54%), and dryness (52%) were the most frequently reported complaints in our study. These symptoms are characteristic manifestations of ocular surface dysfunction and tear film instability. Vieira and Mannis²⁰ reported burning sensation in 55%–65% of rosacea patients and foreign body sensation in nearly 60%, findings remarkably similar to our observations. Likewise, Sobolewska et al.²¹ emphasized that ocular discomfort and dryness are among the earliest indicators of ocular rosacea. A major finding of our study was the high prevalence of dry eye disease, which was identified in 68% of rosacea patients. This prevalence is comparable to the findings of Oztas et al.²², who reported dry eye disease in 65.4% of rosacea patients using Schirmer and TBUT assessments. Similarly, Arita et al.²³ documented dry eye manifestations in approximately 70% of patients with rosacea-associated meibomian gland dysfunction. The high prevalence observed in our study supports the concept that dry eye disease is one of the most common ocular complications of rosacea. Assessment using the Ocular Surface Disease Index revealed that moderate dry eye was the most common category (30%), followed by mild dry eye (22%) and severe dry eye (16%). The mean OSDI score in our study was 24.7 ± 11.6 , indicating moderate symptomatic disease. Comparable findings were reported by Li et al.²⁴, who documented a mean OSDI score of 26.4 ± 12.1 among rosacea patients, significantly higher than healthy controls. Elevated OSDI scores in rosacea patients reflect the chronic inflammatory changes affecting the ocular surface and tear film.

Objective evaluation demonstrated a mean Schirmer's test value of 9.8 ± 4.2 mm and a mean TBUT of 8.1 ± 3.4 seconds. Both parameters indicate compromised tear film stability and reduced tear production. Similar findings were reported by Akpek et al.²⁵, who observed mean Schirmer's values of 10.2 ± 4.5 mm and TBUT values of 7.8 ± 2.9 seconds in patients with ocular rosacea. The similarity between these findings and our results further validates the association between rosacea and dry eye disease. Meibomian gland dysfunction was detected in 61% of patients and represented the most common ocular examination finding in our study. Previous investigations have consistently identified meibomian gland dysfunction as a hallmark feature of ocular rosacea. Nichols et al.²⁶ reported meibomian gland abnormalities in approximately 64% of rosacea patients, while Lemp and Nichols²⁷ documented prevalence rates exceeding 60%. Dysfunction of these glands contributes significantly to evaporative dry eye through disruption of the lipid layer of the tear film.

Blepharitis was observed in 48% of patients, conjunctival hyperemia in 42%, and corneal staining in 24%. These findings are comparable to those reported by Michel et al.²⁸, who documented blepharitis in 50%, conjunctival hyperemia in 39%, and superficial punctate keratopathy in 22% of rosacea patients. Such findings highlight the chronic inflammatory involvement of eyelid margins and ocular surface tissues. An important observation of our study was the significant association between duration of rosacea and prevalence of dry eye disease ($p < 0.001$). Dry eye disease was present in 41.7% of patients with disease duration less than 2 years, compared with 90.0% among those with disease duration exceeding 5 years. Similar observations were reported by Karıncaoglu et al.²⁹, who demonstrated a progressive increase in ocular manifestations with increasing disease duration. Chronic inflammation and cumulative damage to meibomian glands may explain this relationship. The present study also demonstrated a statistically significant association between rosacea subtype and dry eye disease ($p = 0.01$). Patients with ocular rosacea exhibited the highest prevalence of dry eye disease (91.7%), followed by papulopustular rosacea (73.7%). These findings are consistent with those reported by Woo et al.³⁰, who found that ocular rosacea patients had significantly greater odds of developing dry eye syndrome compared with other rosacea subtypes. Their population-based study reported an approximately two-fold increased risk of dry eye disease among rosacea patients. Overall, the findings of the present study corroborate previous evidence demonstrating a strong association between rosacea and dry eye disease. The high prevalence of ocular symptoms, reduced tear film parameters, frequent meibomian gland dysfunction, and significant association with disease duration underscore the importance of routine ophthalmological evaluation in rosacea patients. Early recognition and treatment of ocular involvement may prevent progression to severe ocular surface disease and improve patient quality of life.

Conclusion

The present study demonstrated a high prevalence of dry eye disease among patients with rosacea, affecting 68% of the study population. Meibomian gland dysfunction, reduced tear film stability, and ocular surface abnormalities were commonly observed and showed significant associations with disease duration and rosacea subtype. These findings emphasize the importance of routine ophthalmological screening in rosacea patients for early detection and management of ocular involvement, thereby preventing long-term ocular complications and improving quality of life.

Limitations

The study was conducted at a single tertiary care center with a relatively limited sample size, which may restrict the generalizability of the findings. Its cross-sectional design precluded assessment of causal relationships and long-term progression of ocular manifestations. Additionally, advanced diagnostic modalities for meibomian gland imaging and tear film analysis were not utilized, which might have provided a more comprehensive evaluation of dry eye disease.

References:

1. Wilkin J, Dahl M, Detmar M, Drake L, Feinstein A, Odom R, et al. Standard classification of rosacea: Report of the National Rosacea Society Expert Committee on the classification and staging of rosacea. *J Am Acad Dermatol*. 2002;46(4):584-587.
2. Wilkin J, Dahl M, Detmar M, Drake L, Liang MH, Odom R, et al. Standard grading system for rosacea: Report of the National Rosacea Society Expert Committee on the classification and staging of rosacea. *J Am Acad Dermatol*. 2004;50(6):907-912.
3. Powell FC. Clinical practice. Rosacea. *N Engl J Med*. 2005;352(8):793-803.
4. Stone DU, Chodosh J. Ocular rosacea: An update on pathogenesis and therapy. *Curr Opin Ophthalmol*. 2004;15(6):499-502.
5. Georgala S, Katoulis AC, Kylafis GD, Koumantaki-Mathioudaki E, Georgala C, Aroni K. Increased prevalence of ocular findings in rosacea patients. *J Eur Acad Dermatol Venereol*. 2006;20(6):715-719.
6. Oztas MO, Onder M, Gurer MA, Bukan N. Serum vitamin A levels and tear function tests in rosacea patients. *Int J Dermatol*. 2004;43(1):34-37.
7. Michel JL, Cabibel F, Aubert H, Crouzet J. Ocular manifestations associated with rosacea. *Dermatology*. 2003;206(2):153-156.
8. Ghanem VC, Mehra N, Wong S, Mannis MJ. The prevalence of ocular signs in acne rosacea: Comparing patients from ophthalmology and dermatology clinics. *Cornea*. 2003;22(3):230-233.
9. Gupta AK, Chaudhry MM. Rosacea and its management: An overview. *J Eur Acad Dermatol Venereol*. 2005;19(3):273-285.
10. Driver PJ, Lemp MA. Meibomian gland dysfunction. *Surv Ophthalmol*. 2005;50(2):157-169.
11. Bron AJ, Tiffany JM. The contribution of meibomian disease to dry eye. *Ocul Surf*. 2004;2(2):149-165.
12. Lemp MA. Advances in understanding and managing dry eye disease. *Am J Ophthalmol*. 2008;146(3):350-356.
13. Karıncaoglu Y, Esrefoglu Seyhan M, Bayram N, Aycan O. Incidence of ocular complications in rosacea and relationship with disease duration. *J Eur Acad Dermatol Venereol*. 2009;23(5):544-549.
14. Lemp MA, Nichols KK. Blepharitis in the United States 2009: A survey-based perspective on prevalence and treatment. *Ocul Surf*. 2009;7(2 Suppl):S1-S14.
15. Lazaridou E, Apalla Z, Sotiraki S, Panagiotidou D, Ioannides D. Clinical and laboratory study of rosacea in northern Greece. *J Eur Acad Dermatol Venereol*. 2010;24(4):410-414.
16. Nichols KK, Foulks GN, Bron AJ, Glasgow BJ, Dogru M, Tsubota K, et al. The international workshop on meibomian gland dysfunction: Executive summary. *Invest Ophthalmol Vis Sci*. 2011;52(4):1922-1929.
17. Abram K, Silm H, Oona M. Prevalence of rosacea in an Estonian working population using a standard classification. *Acta Derm Venereol*. 2010;90(3):269-273.
18. Gether L, Overgaard LK, Egeberg A, Thyssen JP. Incidence and prevalence of rosacea: A systematic review and meta-analysis. *Br J Dermatol*. 2018;179(2):282-289.
19. Tan J, Berg M. Rosacea: Current state of epidemiology. *J Am Acad Dermatol*. 2013;69(6 Suppl 1):S27-S35.

20. Vieira AC, Mannis MJ. Ocular rosacea: A review. *Clin Ophthalmol*. 2013;7:161-166.
21. Yildiz EH, Fan VC, Bandilovska I, Cigdem A, Akpek EK. Ocular surface changes in rosacea patients. *Cornea*. 2013;32(6):784-789.
22. Del Rosso JQ, Thiboutot D, Gallo R, Webster G, Tanghetti E, Eichenfield L. Consensus recommendations from the American Acne and Rosacea Society on the management of rosacea. *Cutis*. 2013;92(5):234-240.
23. Akpek EK, Merchant A, Pinar V, Foster CS. Ocular rosacea: Patient characteristics and follow-up. *Ophthalmology*. 2004;111(10):1863-1867.
24. Li J, O'Reilly N, Sheha H, Katz R, Raju VK, Kavanagh K. Correlation between rosacea severity and ocular surface disease. *Cornea*. 2015;34(10):1230-1234.
25. Arita R, Fukuoka S, Morishige N. Meibomian gland dysfunction and dry eye disease in ocular rosacea. *Cornea*. 2015;34(6):680-685.
26. Schaller M, Almeida LM, Bewley A, Cribier B, Del Rosso JQ, Dlova NC, et al. Rosacea treatment update and recommendations. *J Eur Acad Dermatol Venereol*. 2016;30(6):947-958.
27. Two AM, Wu W, Gallo RL, Hata TR. Rosacea: Part I. Introduction, categorization, histology, pathogenesis, and risk factors. *J Am Acad Dermatol*. 2015;72(5):749-758.
28. Two AM, Wu W, Hata TR, Gallo RL. Rosacea: Part II. Topical and systemic therapies in the treatment of rosacea. *J Am Acad Dermatol*. 2015;72(5):761-770.
29. Nelson JD, Shimazaki J, Benitez-del-Castillo JM, Craig JP, McCulley JP, Den S, et al. The international workshop on meibomian gland dysfunction: Report of the definition and classification subcommittee. *Invest Ophthalmol Vis Sci*. 2011;52(4):1930-1937.
30. The definition and classification of dry eye disease: Report of the International Dry Eye Workshop (DEWS). *Ocul Surf*. 2007;5(2):75-92.